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⇒ Circular of Information ⇐
OF

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1898

The International Correspondence Schools

A SYSTEM OF
HOME STUDY in

Railroad, Bridge, Municipal
and Hydraulic Engineering;
Surveying and Mapping.

THE . . .
CORRESPONDENCE
SCHOOL OF

1898

Civil Engineering

FOR WHOM DESIGNED.

The Correspondence School of Civil Engineering is a practical and thorough system of home instruction, without loss of time from work, for:

CIVIL ENGINEERS,
SURVEYORS,
DRAFTSMEN,
CHAINMEN,
RODMEN,
TRANSITMEN,

TRACK FOREMEN,
ROADMASTERS,
SUPERVISORS OF BRIDGES,
TEMPLATE MAKERS,
BRIDGE INSPECTORS,
STRUCTURAL IRON WORKERS,

and all persons interested or engaged in any branch of Civil Engineering, and for those who wish to qualify themselves to fill such positions. It is intended to furnish such instruction in the theory of Civil Engineering and its specialties: Railroad Engineering, Surveying and Mapping, Bridge Engineering, Municipal Engineering and Hydraulic Engineering as to constitute a complete education in these subjects.

4314 JUDGE US BY OUR WORK.

One good way to form an opinion of our Schools is to send to us for a free sample copy of HOME STUDY MAGAZINE, our new monthly for students of technical subjects. Most of the articles in it are written by the Instructors and illustrated by the Draftsmen and Artists of the Schools. Every drawing and illustration in it is made with pen and ink in our own establishment, and the reproductions are zinc etchings made by photographic process. Compare the illustrations and drawing plates and the clearness and completeness of the descriptions of HOME STUDY MAGAZINE with the best work of similar character to be found anywhere, and just as they bear the mark of superiority, so does everything else connected with our Institution. Refer our drawings to any engineer and he will at once admit their superiority.

TESTIMONIALS.

On application, we will send to any address a book of Testimonials from students residing in all sections of the United States, Canada, and Mexico, containing their endorsement of the Schools and system of instruction.

REFERENCES.

Further, to persons thinking of enrolling as students, we will send the name and address of a student living in the same neighborhood, whom they can consult or correspond with as to the practicability of the method of teaching and the value of the instruction imparted.

FINANCIAL STANDING.

The Colliery Engineer Company, proprietors of The International Correspondence Schools, are incorporated under the laws of Pennsylvania, and have a Credit Rating in the Mercantile Agencies of R. G. Dun & Co. and Bradstreet of from \$300,000 to \$500,000.

REMITTANCES.

Remit by Express Money Order, P. O. Money Order, Bank Draft or Registered Letter. Bank Drafts, Express Money Orders and P. O. Orders should be made payable to the order of THE COLLIERY ENGINEER CO., SCRANTON, PA.

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ANNOUNCEMENT.

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THIS CIRCULAR CONTAINS:

FIRST:—A description of the courses of instruction in The International Correspondence Schools ; a list of the instructors ; and a table showing the number of foreign students enrolled, and the countries in which they reside. It also contains a brief history of the schools, and a full description of the method of teaching employed. It shows how admirably the method meets the requirements of those who, for want of time and means, cannot attend regular schools ; and calls attention to its original features, which make it more thorough and practical than correspondence instruction as conducted in other institutions ; to its superiority over night schools and the reading of text-books ; and to the magnificent opportunities our Schools offer professional men and workingmen, superintendents and foremen, mechanics and young men commencing life, to make up deficiencies in education or to increase their acquirements in technical knowledge. It gives the requirements for admission, rules for enrolling, prices of scholarships and other expenses, and information regarding the diplomas and certificates of proficiency granted.

SECOND :—Details of the courses of study in civil, railroad, bridge, municipal and hydraulic engineering ; surveying and mapping ; mathematics and physics ; the prices of scholarships ; terms of payment ; diplomas granted, etc., etc., together with a statement of what civil, municipal, hydraulic, bridge, and railroad engineers, surveyors and their assistants, railroad employes, bridge company employes, bridge inspectors, etc., etc. require to know of the theory of their respective professions, and why they should take advantage of the opportunity offered to study in The Correspondence School of Civil Engineering.

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THE INTERNATIONAL CORRESPONDENCE SCHOOLS.

INCLUDING :

THE CORRESPONDENCE SCHOOL OF MINES,
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THE CORRESPONDENCE SCHOOL OF ELECTRICITY,
THE CORRESPONDENCE SCHOOL OF ARCHITECTURE,
THE CORRESPONDENCE SCHOOL OF PLUMBING, HEATING AND VENTILATION,
THE CORRESPONDENCE SCHOOL OF CIVIL ENGINEERING,
THE CORRESPONDENCE SCHOOL OF RAILROAD ENGINEERING,
THE CORRESPONDENCE SCHOOL OF BRIDGE ENGINEERING,
THE CORRESPONDENCE SCHOOL OF MUNICIPAL ENGINEERING,
THE CORRESPONDENCE SCHOOL OF HYDRAULIC ENGINEERING,
THE CORRESPONDENCE SCHOOL OF ENGLISH BRANCHES,
THE CORRESPONDENCE SCHOOL OF BOOKKEEPING AND STENOGRAPHY.
THE CORRESPONDENCE SCHOOL OF SHEET METAL PATTERN DRAFTING,
THE CORRESPONDENCE SCHOOL OF PEDAGOGY,
THE CORRESPONDENCE SCHOOL OF CHEMISTRY.

THE COLLIERY ENGINEER COMPANY,

PROPRIETORS.

T. J. FOSTER, MANAGER AND TREASURER.



THE CORRESPONDENCE SCHOOL OF CIVIL ENGINEERING.

Scholarships.	Subjects Taught.	
Civil Engineering Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Heat, Geometrical Drawing, Mechanical Drawing, Elementary Graphical Statics, Strength of Materials. Analysis of Stresses, Proportioning the Material, Details of Construction, Details, Bills and Estimates, Steam and Steam Engines, Steam Boilers, Locomotives, Descriptive Astronomy, Surveying,	Land Surveying, Mapping, Railroad Location, Railroad Construction, Track Work, Railroad Structures, Elementary Chemistry, Economic Geology of Coal, Economic Geology of Metals, Blowpiping, Mineralogy, Drainage, Sewerage, Streets and Highways, Paving, Water Wheels, Hydraulic Machinery, Water Works, Dynamos and Motors, Electric Lighting, Electric Railways.

Railroad Engineering Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing, Mechanical Drawing,	Strength of Materials, Surveying, Land Surveying, Mapping, Railroad Location, Railroad Construction, Track Work, Railroad Structures.
Surveying and Mapping Scholarship.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry, Logarithms,	Geometrical Drawing, Surveying, Land Surveying, Mapping.
Bridge Engineering Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing,	Mechanical Drawing, Elementary Graphical Statics, Strength of Materials, Analysis of Stresses, Proportioning the Material, Details of Construction, Details, Bills and Estimates.
Municipal Engineering Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing, Mechanical Drawing,	Strength of Materials, Surveying, Land Surveying, Mapping, Drainage, Sewerage, Streets and Highways, Paving.
Hydraulic Engineering Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing,	Mechanical Drawing, Strength of Materials, Surveying, Steam and Steam Engines Steam Boilers, Water Wheels, Hydraulic Machinery, Water Works.
Mathematics and Physics Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry,	Elementary Mechanics, Hydromechanics, Pneumatics, Heat.

 For full particulars of The Correspondence Schools of Civil, Railroad, Bridge, Municipal, and Hydraulic Engineering, see Pages 55 to 108 of this Circular.

THE CORRESPONDENCE SCHOOL OF PEDAGOGY.

Scholarship.	Subjects Taught.	
Pedagogics of English Branches Scholarship.	Pedagogics of Arithmetic, Pedagogics of U. S. Civil Government, Pedagogics of U. S. History,	Pedagogics of Grammar, Pedagogics of Geography, Pedagogics of Orthography.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF MECHANICS.

Scholarships.	Subjects Taught.	
Complete Mechanical Scholarship.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Heat,	Geometrical Drawing, Mechanical Drawing, Steam and Steam Engines, Strength of Materials, Applied Mechanics, Steam Boilers, Machine Design, Dynamios and Motors.
Mechanical Drawing Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas,	Geometrical Drawing, Mechanical Drawing.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF MINES.

Scholarships.	Subjects Taught.	
Complete Coal Mining Scholarship.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry, Gases Met With in Mines, Mine Ventilation, Geometrical Drawing, Mine Surveying and Mapping, Economic Geology of Coal, Prospecting for Coal, Shafts, Slopes and Drifts, Methods of Working Coal Mines, Mechanics,	Steam and Steam Boilers, Steam Engines, Air and Air Compression, Hydromechanics and Pumping, Haulage, Hoisting and Hoisting Appliances, Mining Machinery, Percussion Drills, Surface Arrangements of Bituminous Mines, Surface Arrangements of Anthracite Mines.
Mine Mechanical Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing, Mechanical Drawing, Steam and Steam Engines, Steam Bollers, Air and Air Compression, Hydromechanics and Pumping,	Haulage, Hoisting and Hoisting Appliances, Mining Machinery, Percussion Drills, Surface Arrangements of Bituminous Mines, Surface Arrangements of Anthracite Mines, Dynamios and Motors, [ations. Electricity Applied in Mining Oper-
Metal Mining Scholarship.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry, Geometrical Drawing, Mine Surveying and Mapping, Blowpiping, Mineralogy, Assaying, Economic Geology, Prospecting, Placer and Hydraulic Mining, Preliminary Openings,	Permanent Openings, Methods of Working Metal Mines, Crushing, Sizing, Concentrating and Amalgamating Machinery, Mechanics, Steam and Steam Boilers, Steam Engines, Air and Air Compression, Hydromechanics and Pumping, Haulage, Hoisting and Hoisting Appliances, Percussion Drills.
Metal Prospectors' Scholarship.	Blowpiping, Mineralogy, Assaying,	Economic Geology, Prospecting, Placer and Hydraulic Mining.

Full Mining Scholarship.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry, Gases Met With in Mines, Mine Ventilation, Geometrical Drawing, Mine Surveying and Mapping, Economic Geology of Coal, Prospecting for Coal, Shafts, Slopes and Drifts, Methods of Working Coal Mines, Mechanics, Steam and Steam Boilers, Steam Engines, Air and Air Compression, Hydromechanics and Pumping, Haulage, Hoisting and Hoisting Appliances, Mining Machinery,	Percussion Drills, Surface Arrangements of Bituminous Mines, Surface Arrangements of Anthracite Mines, Dynamos and Motors, Electricity Applied in Mining Operations, Blowpiping, Mineralogy, Assaying, Economic Geology, Prospecting, Placer and Hydraulic Mining, Preliminary Openings, Permanent Openings, Methods of Working Metal Mines, Crushing, Sizing, Concentrating and Amalgamating Machinery.
	Arithmetic, Mensuration and Trigonometrical Functions, Gases Met With in Mines, etc., Mine Ventilation, Economic Geology of Coal,	Prospecting for Coal, Shafts, Slopes and Drifts, Methods of Working Coal Mines, Mine Surveying, Mine Machinery.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF ARCHITECTURE.

Scholarships.	Subjects Taught.	
Complete Architectural Scholarship.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing, Architectural Drawing, Part 1, Ornamental Drawing, Architectural Drawing, Part 2, Strength of Materials, Masonry, Carpentry, Joinery, Stair Building,	Structural Iron Work, Ornamental Iron Work, Roofing, Plumbing and Gas-Fitting, Sheet Metal Work, Heating and Ventilation, Electric Light Wiring and Bell Work, Painting and Decorating, History of Architecture, Architectural Design, Specifications, Contracts and Permits, Estimating.
Architectural Drawing and Designing Scholarship.	Arithmetic, Mensuration, Geometrical Drawing, Architectural Drawing, Part 1, This Scholarship includes a large number of Drawing Plates.	Ornamental Drawing, Architectural Drawing, Part 2, History of Architecture, Architectural Design.
Architectural Drawing Scholarship.	Arithmetic, Mensuration,	Geometrical Drawing, Architectural Drawing, Part 1.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF ELECTRICITY.

Scholarships.	Subjects Taught.	
Mechanical-Electrical-Scholarship.	{ Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Heat, Geometrical Drawing, Mechanical Drawing, Steam and Steam Engines,	Strength of Materials, Applied Mechanics, Steam Boilers, Machine Design, Principles of Electricity and Appendix, Electrical Measurements and Appendix, Batteries, Applied Electricity, Power Transmission, Dynamo-Electric Machine Design.
Electrical Power and Lighting Scholarship.	{ Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing,	Mechanical Drawing, Dynamos and Motors, Electric Lighting, Electric Railways.
Electric Lighting Scholarship.	{ Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics,	Geometrical Drawing, Mechanical Drawing, Dynamos and Motors, Electric Lighting.
Electric Railway Scholarship.	{ Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics,	Geometrical Drawing, Mechanical Drawing, Dynamos and Motors, Electric Railways.
Wiring and Bell Work Scholarship.	{ Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas,	Electric Light Wiring and Bell Work.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF SHEET METAL PATTERN DRAFTING.

Scholarships.	Subjects Taught.	
Tinsmiths' Pattern Cutting Scholarship.	{ Arithmetic, Part I, Elementary Free-Hand Drawing, Elementary Instrumental Drawing, Elementary Plane Geometry, Practical Plane Geometry, Elementary Solid Geometry,	Practical Projection, Developments, Reading Working Drawings, Laying Out Patterns, Patterns for Plain and Bent Work.
Sheet Metal Pattern Drafting Scholarship.	{ Arithmetic, Mensuration, Elementary Free-Hand Drawing, Elementary Instrumental Drawing, Elementary Plane Geometry, Practical Plane Geometry, Elementary Solid Geometry,	Practical Projection, Developments, Reading Working Drawings, Laying Out Patterns, Patterns for Plain and Bent Work, Patterns for Formed Work, Properties of Materials.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF STEAM ENGINEERING.

Scholarships.	Subjects Taught.	
Stationary Engineers' Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing, Mechanical Drawing (Stationary Division),	Steam and Steam Engines (Stationary Division), Steam Boilers (Stationary Division), Dynamoes and Motors.
Marine Engineers' Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing, Mechanical Drawing (Marine Division),	Steam and Steam Boilers (Marine Division), Steam Engines (Marine Division), Dynamoes and Motors.
Locomotive Engineers' Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing,	Mechanical Drawing (Locomotive Division), Steam and Steam Engines, Locomotives, Dynamoes and Motors.
Traction Engineers' Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics,	Geometrical Drawing, Mechanical Drawing, Traction and Portable Engines, Traction and Portable Machinery.
Gas Engineers' Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Elementary Algebra and Trigonometric Functions, Logarithms,	Elementary Mechanics, Pneumatics, Gas and Petroleum, Heat, Geometrical Drawing, Mechanical Drawing, Gas, Gasoline and Oil Engines.
Refrigeration Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Elementary Algebra and Trigonometric Functions, Logarithms, Elementary Mechanics,	Pneumatics, Heat, Geometrical Drawing, Mechanical Drawing (Stationary Division), Ice Making and Refrigerating Machinery.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF ENGLISH BRANCHES.

Scholarship.	Subjects Taught.	
English Branches Scholarship.	Arithmetic, Spelling, Penmanship or Letter Writing, Grammar,	Geography, U. S. History, U. S. Civil Government.
	The Subjects of this Course are taught separately when desired.	

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF CHEMISTRY.

Scholarships.	Subjects Taught.	
Inorganic and Organic Chemistry Scholarship.	Arithmetic, Elementary Algebra and Trigonometric Functions, Physics,	Theoretical Chemistry, Inorganic Chemistry, Organic Chemistry.
Chemistry, Including Qualitative Analysis Scholarship.	Arithmetic, Elementary Algebra and Trigonometric Functions, Physics,	Theoretical Chemistry, Inorganic Chemistry, Organic Chemistry, Qualitative Analysis.
Chemistry, Including Qualitative and Quantitative Analysis Scholarship.	Arithmetic, Elementary Algebra and Trigonometric Functions, Physics, Theoretical Chemistry,	Inorganic Chemistry, Organic Chemistry, Qualitative Analysis, Quantitative Analysis.
Blowpiping and Assaying Scholarship.	Blowpiping.	Assaying,

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF BOOKKEEPING AND STENOGRAPHY.

Scholarships.	Subjects Taught.	
Book-keeping and Business Forms Scholarship.	Arithmetic, Penmanship, Single Entry Bookkeeping,	Double Entry Bookkeeping, Opening, Closing and Changing Books.
	The Subjects of this Course are taught separately when desired.	
Complete Stenographic Scholarship.	Spelling, Penmanship, Grammar,	Letter Writing, Stenography.
	The Subjects of this Course are taught separately when desired.	
Complete Commercial Scholarship.	Arithmetic, Spelling, Penmanship, Grammar, Letter Writing,	Single Entry Bookkeeping, Double Entry Bookkeeping, Opening, Closing and Changing Books, Stenography.
	The Subjects of this Course are taught separately when desired.	

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

THE CORRESPONDENCE SCHOOL OF PLUMBING, HEATING AND VENTILATION.

Scholarships.	Subjects Taught.	
Sanitary Plumbing, Heating and Ventilation Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing, Mechanical Drawing, Plumbing and Drainage, Gas and Gas-Fitting,	Electric Light Wiring and Bell Work, Principles of Heating and Ventilation, Steam Heating, Hot-Water Heating, Furnace Heating, Ventilation of Buildings.
Sanitary Plumbing and Gas-Fitting Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing,	Mechanical Drawing, Plumbing and Drainage, Gas and Gas-Fitting, Electric Light Wiring and Bell Work.
Sanitary Plumbing Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics,	Geometrical Drawing, Mechanical Drawing, Plumbing and Drainage.
Gas-Fitting Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics,	Geometrical Drawing, Mechanical Drawing, Gas and Gas-Fitting, Electric Light Wiring and Bell Work
Heating and Ventilation Scholarship.	Arithmetic, Mensuration and the Use of Letters in Algebraic Formulas, Mechanics, Geometrical Drawing, Mechanical Drawing,	Principles of Heating and Ventilation, Steam Heating, Hot-Water Heating, Furnace Heating, Ventilation of Buildings.

 We issue Circulars of Information in which the above Scholarships are described in detail; they are sent free on application. When sending for circulars please state the Course in which you are interested.

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Principal.

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S. COLEMAN,
B. BYRON,
J. WALTON,
G. McDERMOTT,
M. BOLAND,
M. HURST,
M. O'DONNELL,
L. O'NIELL.

SCHOOL OF MECHANICAL ENGINEERING

C. P. TURNER, M. E.,
Principal.

INSTRUCTORS.

L. E. RAFTER,
M. J. BRENNAN,
G. W. SHOPLAND,
A. T. MAHON,
M. R. HORAN.

SCHOOL OF CIVIL ENGINEERING.

BENJAMIN F. LA RUE, Civil Engineer,
Principal.

INSTRUCTORS.

L. RECHSTEINER,
B. E. CONGER,
M. L. MOFFITT,
A. C. COLLIGAN,
L. J. WEAVER,
L. F. CLARK,
J. M. THOMAS,
M. A. CALLAHAN.

SCHOOL OF MINING ENGINEERING.

DEPARTMENT OF COAL MINING.

J. T. BEARD, E. M.,
Principal.

INSTRUCTORS.

L. V. MALIA,
M. A. HASTINGS,
S. G. DOUGHERTY.

SCHOOL OF MINING ENGINEERING.

DEPARTMENT OF METAL MINING.

J. E. DWELLE, E. M.,
Principal.

INSTRUCTORS.

A. C. THOMPSON,
F. H. LERCHEN, E. M.,
M. A. LYNCH.

SCHOOL OF ARCHITECTURE.

W. SCOTT-COLLINS,
Principal.

INSTRUCTORS.

M. DONNEGAN,
A. E. BRECK.

SCHOOL OF SANITARY ENGINEERING

THOMAS N. THOMSON,
Principal.

INSTRUCTORS.

K. M. ORR,
C. O'HARA.

SCHOOL OF ELECTRICAL ENGINEERING.

WM. H. DONNER, Electrical Engineer,
Principal.

INSTRUCTORS.

K. G. MALIA,
S. J. GAVAN,
A. L. NICOLS,
A. A. HINE,
N. HART.

SCHOOL OF ENGLISH BRANCHES.

C. W. FAUST, M. of E.,
Principal.

INSTRUCTORS.

B. C. CONGER,
L. CONNER,
M. VON PLEES.

SCHOOL OF BOOKKEEPING AND STENOGRAPHY.

N. H. PROUTY,
Principal.

INSTRUCTOR.

R. W. KELLOW.

SCHOOL OF DRAWING.

L. H. KJELLSTEDT, C. E.,
Principal.

INSTRUCTORS.

F. M. SCOTT,
C. COKELY,
F. I. MELLON,
M. D. MURPHY,
C. B. EDSON,
N. LOFTUS,
L. McANDREWS,
A. WILLIAMS,
M. D. LANGAN,
A. C. BLEWITT,
A. A. CALLAHAN.

SCHOOL OF CHEMISTRY.

G. H. DIMPFEL, Ph. D.,
Principal.

SCHOOL OF PEDAGOGY

WM. B. RIDENOUR, A. M.,
Principal.

ILLUSTRATING DEPARTMENT.

CHAS. J. HAYES
Chief.

DRAFTSMEN.

JOHN A. GRENING,
D. COMINGS,
RUDOLPH PRESCH,
MICHAEL J. SCANLON,
HENRY LITT,
EMIL MOODY,
HARRY ARTLEY,
WALTER C. FELLOWS,
ADAM KAUFMAN,
FRED. G. WARING,
MILTON CONNEL,
E. H. MAROT.

CLASSIFIED LIST OF STUDENTS AND GRADUATES

Outside of the United States, Canada and Mexico.

FEBRUARY 1st, 1898.

NORTH AMERICA.

Antigua.....	1	Hayti.....	2
Bermuda.....	2	Jamaica	5
Cuba	3	Newfoundland	8
Great Miquelon Island.....	1	Saint John Island.....	1
Greater Republic of Cent. America	4	Santo Domingo	4

SOUTH AMERICA.

Brazil.....	1	Colombia.....	6
British Guiana	5	Ecuador	1
Chile	2	Venezuela	1

EUROPE.

Belgium	2	Russia	1
Denmark.....	1	Scotland	13
England	52	Spain	2
France	3	Sweden.....	2
Germany.....	8	Switzerland	2
Gibraltar.....	1	Wales.....	7
Italy.....	1		

ASIA.

Asia Minor.....	1	Japan.....	20
Burmah	1	Java.....	1
Ceylon	1	Siam	3
China	4	Straits Settlements	3
India	11		

AFRICA.

Angola	1	Mauritius	1
Cape Colony.....	2	Namaqualand	3
East Africa.....	1	Natal	5
Madagascar	1	Rhodesia.....	2
Madeira	1	South African Republic.....	30
Mashonaland	1	Zanzibar	1

AUSTRALASIA.

Hawaiian Islands	17	Queensland	1
New South Wales	11	Tasmania.....	6
New Zealand	11	West Australia	1

NOTE.—Anyone desiring may verify these figures by calling at our offices, at Scranton, Pa.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS.

“To be accurate, write;
To remember, write.”

The International Correspondence Schools were first to give instruction by correspondence in the theories of the trades and engineering professions, and have done more within the last five years to benefit miners, mechanics and others in need of technical instruction than any other educational institution. The system of instruction thus originated has developed into the largest technical school in the world, has overcome the difficulties which attend these classes in their efforts to educate themselves at night school or by home study with text-books, has placed technical education within the reach of thousands who would otherwise have remained in ignorance of the theories of their trades, and has helped hundreds to become superintendents, foremen, draftsmen, engineers, etc. who, without it, would never have obtained such positions.

History of Correspondence In- struction.

The man who first transmitted written intelligence to his neighbor originated correspondence instruction, and it has always been largely used among civilized people. All who are familiar with the New Testament know how generally the method was employed two thousand years ago.

The man who reads the world's doings in the newspapers, or the mechanic who is kept informed of the progress in his trade by his favorite technical journal is instructed in a measure by correspondence; and to a greater or less degree the same principle is made to contribute to all mental improvement.

Application by Us to the Theories of the Trades.

In the last twenty-five years the method has come into more general use, but until within a very few years all teaching by correspondence was conducted with regular text-books, which are not as well adapted to correspondence instruction as text-books especially prepared for the purpose. Most workmen do not have the preliminary education to understand ordinary text-books. Neither have they time to waste in studying things they will never use. In The International Correspondence Schools these conditions are met by courses of instruction which begin at the beginning, require only a knowledge of reading and writing on the part of the student to commence, and for which the Instruction and Question Papers and Drawing Plates used in teaching have been expressly written and illustrated. To do this writing and illustrating has required an expenditure of nearly \$200,000, but without it such growth as these Schools have experienced would have been impossible.

RAPID GROWTH.

An Original Undertaking.

In the month of August, 1891, the work of the first course (what is now the Complete Coal Mining Course) was laid out, and *the decision was made to prepare for use instead of text-books a series of Instruction Papers which should embody in the fewest and plainest words everything necessary to a complete understanding of the subject.* From this decision dates the beginning of correspondence instruction as now conducted.

Its Great Success.

The course became popular at once, because it presented to miners and mine officials an opportunity to obtain a systematic, thorough, and concise course of home instruction in the theory of coal-mining. Within one year, over one thousand men enrolled, and the great value of the new method of teaching to the large class who desire to obtain technical educations but cannot leave home or quit work to attend the regular schools was demonstrated.

Complete Mechanical and Mechanical Drawing Courses.

Early in 1892 the demand from machinists and others who wished to qualify to become mechanical engineers and draftsmen became so urgent that the preparation of the Complete Mechanical and Mechanical Drawing Courses, intended especially for these classes, was commenced. Within eighteen months from their establishment, over two thousand enrolled in them.

Steam Engineering, Electrical, Architectural, Civil Engineering and other Courses.

Since that time courses in Steam Engineering, Electricity, Architecture, Architectural Drawing, Civil Engineering, Bridge Engineering, Railroad Engineering, Surveying and Mapping, Municipal Engineering, Hydraulic Engineering, Plumbing, Heating and Ventilation, Chemistry, Sheet Metal Pattern Drafting, Pedagogy, English Branches, Bookkeeping, Stenography, etc. have been added, and the Schools have continued to grow until instruction is now given in over forty Scholarships. A large enrollment in every quarter of the globe attests the great and growing appreciation by workmen everywhere of the work we are doing in placing the gist of college educations within their reach.

Practical Plan of Home Study.

The Schools are not, however, intended to take the place of the regular technical schools and colleges, and those who are in position to attend such institutions are advised to do so. Our province is to provide education for the thousands who must improve themselves at their own homes after working hours, or not at all. For the first time, a practical and efficient system of instruction is offered to these classes.

Adapted to the Needs of All.

Correspondence instruction is adapted to all. We accept students of any nationality or color, sex or religion, from ten years old upward, and point with well-earned pride to the thousands whom we have benefited. Heretofore, age, time, and expense have largely controlled the educational acquirements of men. None of these factors are now barriers to advancement. By the correspondence method those of mature years may benefit themselves as well as the young and inexperienced. The value of every hour is enhanced by the ability to use it in preparing for advancement. The expense is reduced to a minimum.

Our Success in Teaching. Persons who think of enrolling and who wish evidence regarding the method of instruction, from those who have already tried the plan, should write us, and we will send them a copy of a book of testimonials, or the name and address of a student in any locality, to whom they can write for information.

METHOD OF TEACHING.

The method of instruction in such subjects as can be taught without the use of apparatus or instruments, is as follows :

Short Lessons. The Instruction Papers which are the text-books for our students are printed pamphlets or books of 30 to 150 pages, and are accompanied by Question Papers.

When a student enrolls he receives the first two sets of Instruction and Question Papers. Accompanying these are printed instructions telling him what his class letter and number is, how to proceed with his work, and how to study. After reading these instructions the student studies his first Instruction Paper. The first subject is either arithmetic or drawing, but whichever it is it is commenced at the very beginning, on the assumption that the student knows nothing of it, and the ground is covered in the clearest and most concise language. Usually the first subject is arithmetic.

How the Student Studies. After having mastered the first Instruction Paper, the student lays it aside and takes up his Question Paper (which contains many practical problems), and answers in turn every question, upon sheets of foolscap, writing on one side of the paper only ; he then puts his work in an addressed envelope (which is provided for the purpose) and mails it.

Correction of His Work. When a set of answers is received by the School, it is examined with the utmost care ; all errors are corrected in red ink, and the work is returned with such suggestions and criticisms as enable the student to understand the subject. Every mistake is pointed out and everything fully explained.

The Instructors take pains to make the student feel that the comments made are for his best interests. Experience has shown that written criticisms make more lasting impressions than verbal ones.

Percentage Marks. A percentage mark is given according to merit. If the paper does not deserve 90 per cent., the student is required to rewrite the incorrect part until he satisfies the Instructor that he understands it. If necessary, additional work is given him. The student is kept at the subject until he has learned it.

When students do not receive 90 per cent., which is not often, the trouble is almost always traceable to their failure to study the Instruction Papers carefully. The Instruction Papers are *so plain* that any who will study them as directed can understand them, and *so complete* that any who understand them can readily answer all the questions asked.

How the Student is Kept at Work. When the student mails his work on Question Paper No. 1, he commences the study of Instruction Paper No. 2, and proceeds with it as with the previous Paper.

When he has gained a passing-mark in Question Paper No. 1, his work is returned to him to keep, and at the same time Instruction Paper No. 3 and Question Paper No. 3 are sent him.

When he receives No. 3 Papers, he lays them aside until he has finished No. 2. When he mails his work on No. 2, he takes up No. 3, and when his work on No. 2 is returned to him, he is sent No. 4 Papers, and so on. By this system he has always a set of Papers on hand to study while the work on the other set is going through the mails.

**He Receives
Personal
Assistance.**

When a student meets with difficulty in understanding anything in the Papers, the Instructors of the School come to his assistance through the mails.

For this purpose each student is furnished by the School, free of charge, with addressed envelopes and information blanks. A copy of the latter is printed on the next page.

When the student has given a subject a thorough trial and cannot understand it, all he has to do is to state his difficulty on one of these blanks, and mail it.

Full Explanations.

When this is received, the Instructor answers it by return mail. *He explains fully, if it requires a dozen sheets of paper to do so.*

We would rather have a student write to us for explanations every day, than fail to understand a principle or anything treated of in the Instruction Paper.

Bound Volumes of Instruction and Question Papers.

In addition to the Instruction and Question Papers furnished to him to study from, the student receives when he enrolls, and without extra charge, (except for expressage or freight), a complete set of bound volumes of all the Instruction Papers, Question Papers, Keys, etc., used in the said course of instruction, together with the Tables belonging thereto and an abstract of all the Formulas used in the course, all fully indexed, and bound in half leather.

All Text-Books are Free.

The Instruction and Question Papers are the only text-books the student requires. They become his property, and are not returned to us.

We pay all postage in sending all other books, papers or communications to the students. They pay the postage on their mail to us.

When a man has completed a course he must pass a final examination before he is given a Diploma or Certificate of Proficiency.

School Records.

The records kept are very full. They form a complete school history of the student from his enrollment until he receives his Diploma.

They contain not only the percentages given upon each Plate and Question Paper, but such details of his work as to enable us to form an accurate opinion of his ability and status as a student.

Information
Blank.

The International Correspondence Schools.

SCRANTON, PA., U. S. A.

Observe the following Points when Using this INFORMATION BLANK:

- When to be Used.** (1) Use it whenever, after a fair trial, you cannot understand the principles stated in the Instruction Papers or cannot work the problems in the Question Papers.
- (2) Be sure to give ALL the data asked for on this blank.
- How to be Used.** (3) When asking for information regarding an example, the printed answer of which you are unable to obtain, ALWAYS SEND US YOUR SOLUTIONS or your work as far as you can go, thus we can see just where your error lies, if any exists, and we can give you exactly the information you need. Sometimes your answers may differ from ours owing to the number of decimal places carried (usually four are sufficient, but some calculations require more). We make no deduction from your mark in such cases provided your work and principle are correct.
- (4) ALWAYS WRITE YOUR ADDRESS IN FULL ON EVERYTHING YOU SEND US.

USE THE YELLOW BLANK LAST.

Name of Student.....Class Letter and
No.....Post-office.....State.....
No. of Question.....Page.....
In the.....edition of Paper, subject.....

Date.....189.....

HOW DRAWING IS TAUGHT.

Unsurpassed Method of Teaching Drawing. Our method of teaching drawing is original, practical, and unsurpassed in any school in the world. It is unequalled except in a very few regular universities and technical colleges of the highest grade. None have ever failed to learn to draw by our method when they have followed our instructions. Many have been qualified to fill positions as draftsmen who, before they enrolled with us, had never used a drawing pen or pencil, and whose hands and fingers were as rough and stiff, because of hard work, as they could well be.

Every Drawing Original with Us. It seems an incomprehensible thing to many how drawing can be taught through the mails, yet we have qualified thousands to make neat, well-lettered drawings without ever seeing or conversing with them. This is due to the merit of our Instruction Papers on drawing, to the care taken in correcting the work of students, and to the character of the model drawings which we send to students to work from. All of these drawings are made with pen and ink in our own establishment, and the copies sent to students are printed from zinc etchings made from them by the photographic process. The preparation of these drawings has taken much time and money.

Instruction Carefully Graded. In our drawing courses the student is not required to draw first a hard plate, then an easy one, then a hard one, and then another easy one, etc. His first plate consists of a few simple straight and curved lines, his second is a little more difficult, his third still more so, and so on. The last plates in the course are as difficult as any ordinary draftsman is ever called upon to draw, and by the time our students reach the last plates in their courses, the work which they do upon them will compare very favorably with that done by any draftsman.

First Instruction Paper and Drawing Plates. When the student is ready to take up this subject, the first Instruction Paper in drawing, together with an empty mailing tube, is sent to him. This Instruction Paper contains detailed instructions on the use and care of the drawing instruments, on penciling, inking, etc., and also for drawing the first few plates.

The student studies the Instruction Paper and draws Plate I, which when completed he sends to us, in the mailing tube above mentioned, for examination and correction.

Important Work of the Instructor. When the plate is received at the School, the Instructor in drawing examines it carefully and notes upon it in pencil the points in which it can be improved and his suggestions for the guidance of the student. If necessary, he writes a letter covering everything thoroughly, so that the student may have full benefit of his knowledge and experience.

The plate is then returned, with these criticisms and suggestions, to the student. If he has not received a mark of 90 per cent., he is obliged to redraw it until he does, which will not be until we are satisfied with the neatness and accuracy of the drawing, and believe that he thoroughly understands the principles involved.

When the student receives a passing-mark on Plate I, he sends us Plate II, on which he has been working while Plate I has been in our hands, and begins work on Plate III.

Order of Work.

The student is required to make from fifteen to forty plates and two or more tracings, depending upon the course in which he enrolls. The plates and tracings, excepting the first few, which are drawn from directions in the first Instruction Paper, are furnished to the student one at a time in the same order as the Instruction and Question Papers in other subjects. Thus, when Plate VIII is returned to the student, it is accompanied by a copy of Plate X, and so on. In this way the student is never out of work, but we do not send plates in advance of the order in which we have arranged them for teaching.

Second Instruction Paper.

Tracings and Blue-Prints.

In due order and with the proper plate the second Instruction Paper in drawing is sent to the student. This explains the advanced principles, gives directions for the work on the remaining plates, and contains full instructions for tracing, preparing blue-print paper, and taking blue-prints.

We reserve the privilege, provided we desire to exercise it, of retaining several of the plates made by each of the students, to show the progress they make.

ADVANTAGES OF CORRESPONDENCE INSTRUCTION.

Deficiencies in Education Can be Made Up.

Our method fills a great want, and fully fills it. It is an opportunity for the indigent student to get an education ; for the superintendent of an engineering establishment, who, by his natural gifts, has attained a position of prominence, to make up the defects in education which hamper him in his efforts to climb higher ; for the ambitious workingman to secure independence ; for the poor man to redeem himself from poverty. He can study and work at the same time ; improve his mind and use his hands to earn the money to support himself and family ; make use of the odd bits of time, which, wasted, are not even missed, but which will enable him in a few years to become a leader in any department of knowledge.

Individual Instruction at Time and Place Best Suited to Student.

By the correspondence method each student is a class in himself.

He can select his own time for study and can carry his studies with him, so that whenever and wherever he has any spare time he can make good use of it.

Wherever the mails go the student can be taught, so that locations may be changed as often as desired.

He can study at home without interfering with his work or social engagements. He loses no time in going to and from school.

When he has studied as long as he wishes he can retire, as he is at home and need not make a long trip on foot or in some conveyance.

The education goes to the student instead of the student going to the education.

Qualifies for Written Examinations. Correspondence instruction strengthens those faculties which are particularly called into play at examinations—the power to correctly and promptly write out on paper answers to questions asked. Many a candidate has failed at an examination, because he was not able to write out answers to the questions fully and clearly, although he knew what the answers should be.

When we write we unconsciously seek to express our ideas in as concise a manner as possible, for the reason that writing is more difficult than speaking. The ability to express things concisely is of great importance to every person.

Instruction Confidential. The correspondence student does not need to expose his ignorance to his associates.

Requires Thoroughness. In his recitations a smooth tongue will not aid him to conceal his ignorance of a subject. What may seem when spoken to be an intelligent, clear explanation of a subject, when written often appears indefinite, vague, and unsatisfactory. Written lessons are subject to more searching scrutiny than oral lessons. The correspondence student soon learns what every student must, that only persistent toil can crown his efforts with success. This creates self-dependence.

Every part of a correspondence lesson can be gone over repeatedly until it is fully understood.

Even the misfortune of partial or entire lack of occupation may be turned to advantage by this method of home study.

The method tends to form habits of accuracy, since nothing can be skipped and the whole lesson must be learned and written.

Forms Habits of Accuracy. Wise direction through correspondence by competent Instructors will produce better results than can be expected from unaided individual efforts, but while the student has the most skilful direction in his studies he is at the same time his own schoolmaster, and pursues his work without fear, constraint, or obligation. He studies because he desires knowledge which will aid him in his efforts for advancement, and not because he is obliged to.

Close Relations of Instructor and Student. The relations of Instructors and students are more personal than is possible by any other system. In some colleges teachers have classes so large that they do not even know the majority of their pupils by sight. In such classes it is impossible for a student to receive personal instruction. The teacher cannot even give his whole attention to the one pupil who is reciting. He is obliged to keep the large class in order, and so necessarily is less careful than if occupied with but one at a time. On the other hand, the correspondence Instructor, in reviewing and correcting the work of one student at a time, is interested in him alone, and therefore can better see his defects. He does not know his pupil, and cannot be influenced by him in any way.

OUR IMPROVED METHOD.

- No Fixed Time for the Completion of Our Courses.** Recognizing that men who have but little time to devote to study should not be bound to a fixed time for the completion of their courses, The International Correspondence Schools do not have a fixed time for the beginning or completion of any course or any part of it. Persons may enroll at any time; their instruction is commenced immediately, and we enter into a definite agreement with each one that as soon as his Scholarship is paid in full it shall be non-forfeitable, and continue in force until instruction is furnished in all the subjects included in it; that the student may lay aside his studies as often as he may find it necessary, and resume them again when he finds it convenient; that when Scholarships are purchased on the installment plan they are not forfeitable for failure to pay the installments promptly, and that if at any time the student desires to stop studying, he has the right to sell or give his Scholarship to some other person.
- Scholarships Nonforfeitable and Transferable.** Special information is furnished students as often as desired, on blanks supplied by the School.
- We Write and Illustrate Our Texts.** We write and illustrate, expressly for the purpose, all the text-books we use in teaching. This is necessary in order to insure the highest degree of accuracy, completeness, conciseness and simplicity. We employ a large staff of engineers and draftsmen exclusively in this work.
- Our Texts Are Accurate.** Our text-books are original in composition and illustration, and are not compilations from other technical works. Only the most competent engineers are engaged to write them. Each paper is edited by several other engineers, well versed in the subject of the paper. Two expert operators check on calculating machines every calculation. A large and costly library of standard scientific and technical works is at hand for reference. Our text-books contain fewer errors than any other text-books on the subjects of which they treat.
- We Take Nothing for Granted.** All of our papers are written from the standpoint that the student has no other source of information. Our Instructors in writing the papers endeavor to place themselves in the position of persons ignorant of the subject and then try to explain the various points. They try to provide for all the difficulties that will be likely to beset the students, and as a result, many things of great importance in practical work, which receive little or no attention in ordinary text-books, are treated fully. Nothing of value is omitted from any course.
- Unnecessary Matter Left Out.** In explaining a subject our instructors make every point clear, regardless of the space required to accomplish it, but at the same time every paper is made as concise as the nature of the subject will permit. Our students are not carried so deeply into some subjects as in the regular technical schools, because we leave out everything not necessary for them to learn in order to master the subjects we are teaching them. The study of scientific subjects is always interesting, and helps to train the mind, but our students are busy men who cannot afford to

waste a minute in learning things unnecessary to a thorough knowledge of the theory of their occupations.

**Simplicity
Secured at
Any Cost.**

Our Instruction Papers are written in clear, simple language, as free as possible from technical terms. Illustrations, wherever they will make the text plainer, are used freely. Great pains is taken to make the construction of sentences, the paragraphing, punctuation, etc., such as will make the meaning of the author clear, and the paper easier to study. Words whose meanings are not generally understood are avoided wherever possible for those more commonly used. The plan of simplicity was not adopted because we expected to teach only men of limited education, but because simple language is more readily comprehended by all. One of the greatest troubles with ordinary text-books is that they are written for men of scientific attainments.

**Careful Preparation and
Revision.**

The aim kept in view in the preparation of our Instruction Papers has been to make them thorough, modern and plain. We are constantly revising our texts, some of which are in the fifth edition.

Every Scholarship includes a complete duplicate set of bound volumes of all the Papers used in the Course.

When the student enrolls he is first taken in hand by a competent Instructor in mathematics. This teacher does not ask what the student knows or does not know. He assumes that he knows nothing and begins with him at the beginning of arithmetic. Sometimes a student says, "I don't want to bother with these things," but he is ready to confess afterward that the preliminary drill in arithmetic has made him more efficient.

**System
Thorough.**

After the student is through with arithmetic he is taken into the other subjects, and goes through in regular order the mathematical and physical studies before he is allowed to undertake the advanced subjects. He masters each Instruction Paper in order, and his work is examined and passed upon by the Instructors, subject by subject, as he completes it. The student must be thorough, as he cannot advance unless he is proficient in preceding lessons. He must know arithmetic before he can study mensuration or algebra, and when he gets as far as the last subject in any of our technical courses, he has completed all the subjects entering into a complete education in the branch of engineering he is studying. Our system thus overcomes the greatest objection to self-education by text-books, night schools, etc.—i. e., that many of those compelled to resort to such aids to self-education read or study on so desultory a plan that they learn few things thoroughly.

**Particular
Attention
to Backward
Students.**

We make our students do their work as it ought to be done, allow no medium papers to pass, and correct every error. When the answer papers are examined we even correct and criticise the punctuation, capitalization, spelling and penmanship. The poorly written, poorly expressed paper receives as careful examination and consideration as the good one.

Students are surprised in many instances to see with what care their work is examined, and how clearly and with what apparent ease they are helped to master portions which puzzled them. A successful teacher once said, "The true art of teaching consists in knowing how to suggest."

An Inexpensive Method.

Our method is much less expensive than any other, for the reason that our students do not need to purchase any textbooks whatever.

COMPARED WITH REGULAR SCHOOLS.

To take a course in a regular technical college is the best way to secure a technical education, but it is not possible for busy men to attend colleges.

Our Schools are not intended to fill the place of these, but there are, nevertheless, some respects in which our method of teaching is superior to all other systems.

Correspondence Lessons Require Close Attention.

In any class lecture the attention may be drawn away by the surroundings. Oral explanations cannot always be grasped and retained in the memory as they are given, and while the student is thinking over a portion of the lesson, the teacher may get ahead of him; and if he loses part of the lesson, he cannot understand the remainder. The directions and instructions given are general, and the student oftentimes fails to get assistance on the point which, in his case, is most necessary. On the other hand, the correspondence student goes from one point to another only as he masters the previous one; further, his recitations being written, bring out clearly every weak point and enable the Instructor to know just how to proceed.

The Teacher Instructs One Pupil at a Time.

The correspondence teacher comes in closer contact with the student than do teachers instructing large classes. When the Instructor is correcting the work or giving aid to the correspondence student, his mind is occupied with him alone. This results in better work on the part of the Instructor for the student than is possible when his attention is divided.

Writing a Lesson Helps One to Remember It.

To remember a thing it is necessary to learn it well. To learn it well the attention must be fixed, so that a complete and clear impression may be made on the mind. It will be admitted that a thing which is both heard and read, better commands the attention, and is better understood than if heard only or if read only, and it is equally true that things which are read until they are understood and are afterward written down, are better remembered than those which are read only. They are remembered better because they are learned better.

Practice obtained by correspondence students in writing all their work is a great benefit in preparing them to successfully pass written examinations.

Dull Students Succeed as Well as Bright Ones.

Each student is a class by himself, and his progress depends upon the time he can devote to study. One man may get through in a year, whereas it may take another longer, *but he reaches the goal all the same.* This is more than can be said of

the regular schools, since in all of them students must keep up with the classes or drop the studies.

Nothing Interrupts the Work.

There are no vacation seasons. Nothing interferes to interrupt the work of the student. Persons can commence their studies any day of the year, and be as sure of thorough instruction if they begin at one time as at another. Studies can be interrupted whenever necessary, and resumed when convenient.

Books, Transportation, Board, Etc., Saved.

Our charges are much smaller than for similar courses in the regular schools. In addition, the student saves transportation to and from the school; board, and other expenses while there; books, etc. In studying with us he need not lose a moment from his work, or spend an hour away from home from the time he enrolls until he has earned his Diploma or Certificate of Proficiency.

Any person who wants to learn can do so by the correspondence method. Instruction can be imparted with as great facility by it as by any other means, and many learn by it who cannot be instructed in the usual way.

Competent Instructors.

In The International Correspondence Schools students are taught by the ablest Instructors it is possible to procure, men of education and of large experience in the branches which they teach. These are assisted in the preparation of the Instruction and Question Papers by the ablest specialists in the country, who are employed expressly for the purpose. The students, therefore, have the advantage of the knowledge and experience of the ablest engineers and experts connected with the sciences they are studying.

Those who have tried instruction by correspondence say there is nothing more enjoyable than being one's own schoolmaster. All restraints, study hours, etc. are self-imposed and may be removed or changed at will.

SUPERIORITY OVER NIGHT SCHOOLS.

Night Schools Unsatisfactory.

Besides the many other disadvantages attending them, night schools teaching technical subjects must be located in populous districts, to justify the employment of competent instructors, so that they are only found in the largest cities.

They fail to meet the great want of a system of teaching which can be taken advantage of by working, business, and professional men. When these classes use night schools, in ignorance of a better system, the results are not satisfactory.

Workmen Need Not Leave Home to Study by Our Method.

In the case of the average mechanic, about half the time that he has to devote to study is lost in putting himself in presentable condition to attend the night class and in the ride or walk to and from the place where it is held. He must go from home in all kinds of weather, and is sometimes unable to attend.

Few Can Attend Evening Classes Regularly.

Many cannot attend evening classes regularly. Their engagements to do so are unavoidably interrupted by the sickness of themselves or their families, or by important family or social duties. Men who are sufficiently ambitious and energetic to study in their leisure time are such as usually stand best with their employers, and if a breakdown occurs or an extraordinary emergency arises, are called upon to do night work. Again, the appointed hours are not always those which best suit them. If they lose a single lesson, it places them at a great disadvantage, because they do not understand what follows. It thus occurs that out of every four students attending night schools one is absent at every session, and only one in twelve completes the subjects taken up.

Our Students Are Not Pushed nor Retarded by Others.

In a night school the students must keep a uniform pace in their studies, and it is either a pace too slow to suit the bright student or too fast for the dull one to keep up.

The correspondence student loses no time in going to and from school, but can study at home, without interfering with his work or social engagements, and when he misses an evening can pick up his studies just where he left off.

Studies Carried on Privately.

His objections to revealing to others his present knowledge or his rate of progress are respected, and nobody but his Instructor knows where he begins or how fast he gets along.

MUCH BETTER THAN HOME STUDY WITH TEXT-BOOKS.

Cheaper.

A course in our Schools is much less expensive than home study with text-books. It costs hundreds of dollars to purchase books to cover the theory of a trade and the sciences related to it. Our students require no text-books except the Instruction Papers, which are furnished free of charge. When they enroll, however, they each receive a complete set of bound volumes of all the Instruction Papers, Question Papers and Drawing Plates used in their courses, and these, taken together, form a complete series of text-books in the theory of the trade or profession to which they relate.

Includes the Preliminary Education Required.

The want of preparation in studying with text-books is a great hindrance. A student desiring to study, say Mechanics, selects a book on the Steam Engine and reads. He soon feels there is something which he must learn before he can understand what he is reading. Glancing through the book he sees

$H. P. = \frac{P a F}{33,000}$, asks someone what it means, and is dis-

heartened by being told that it is "Algebra." This is something he does not understand, and he lays the book aside with the conviction that it is too deep for him. This is an example of what befalls him in every branch of his reading. In all text-books it is taken for granted that the reader has some preparatory education, and if he has not he cannot read understandingly.

- Provides an Order of Study.** Another great fault of the system of self-education with text-books is that the learner is "a blind leader of the blind." Text-books are countless in number, and many contain matter which is of little use, and unless the student has the assistance of some experienced person to point out what it is advisable to read, and what may be left alone, he will do much unnecessary reading and lose valuable time. By our method the student commences with addition, and in order learns the various parts of arithmetic; then takes up the next subject and passes through it in the same way, and so on until he thoroughly learns all the subjects in his course. He is not passed in a principle or subject until he understands it, so that when he commences the study of any subject of his course he has mastered all the simpler ones preceding it.
- Aided by Instructor.** He wastes no time, because he is carefully guided in all his work, and he makes rapid progress because he has the aid of the best Instructors.

A GREAT OPPORTUNITY FOR WORKINGMEN.

- Desire for Improvement.** Few are satisfied with what they have in life; the large majority are reaching out for something better. This desire for improvement is the incentive to education and invention; it influences the ablest scientist and the humblest workman; transforms night into day, swamps into cities, and deserts into gardens. To it we owe the advancement of the human race.
- Why Workingmen Are Left Behind.** In the race of life the man who earns his bread by work with his hands is generally the one left behind. Such a man, endowed with the same brain power as others, wonders at times why he is not more fortunate. The problem is easily solved. Compelled to leave school at an early age, hard labor is his only resource.
- He would have made a better place for himself had he received a better education with which to begin. Because of this want of education he is compelled to work under the supervision of others.
- Advantages of Education.** Two men working side by side each do a certain stint, the one with much less exertion than the other. One knows the theory of mechanical forces and applies these forces to assist him. The man who has the most knowledge, and not the man who puts forth the most strength is the most profitable workingman. For example, an artisan may understand the use of a piece of timber, but be unable to calculate the dimensions required for stability and safety. The latter qualification requires a knowledge of laws not learned in the ordinary routine of a man's daily toil.
- Hypothesis.** Most workingmen confuse the word *theory* with *hypothesis*. A statement advanced, but not proven, is an *hypothesis*. A statement of something which has been proven by the experience of men, is a *theory*.

Theory.	Theoretical education (or a knowledge of the experience of those who have preceded him in his trade or occupation) is necessary to the ambitious workman who, not content to remain at the foot of the ladder, desires to climb its rounds and secure promotion. Its great value is admitted in all industries, and those who are without it are placed at a disadvantage in the struggle for success. Experience is absolutely necessary to make one expert in any trade or profession, but unless it is supplemented by technical (or theoretical) education, it will not qualify a person to gain the front rank.
Practice.	
Demand for Educated Labor.	The fact that the demand for skilled and intelligent labor is greater than the supply is proof that workingmen need education in the theory of their work, to enable them to better perform their duties and secure higher positions.
To Secure Promotion—Study.	“The best way to secure promotion is to increase in efficiency, to prove one’s self larger than the position he occupies.” It is the duty of all men to take advantage of every honorable opportunity to improve their financial and social positions and the conditions of themselves and families. Workingmen who make such efforts to advance are seldom discharged, are the last to be laid off when work is slack, and are the first to win promotion.
Workingmen Desire Education.	Most workingmen feel their need of education, and by their hearty response to every effort to assist them, show how much they want to get it, but the means heretofore provided have not been adapted to their conditions.
Their Requirements for Study Fully Met.	To study successfully, the workman must be able to take up his studies whenever it suits his convenience, and lay them down whenever he finds it necessary. If he has a half hour of leisure during the day he must be able to take advantage of it. He cannot afford to lose, in dressing or in a long ride or walk, the hour succeeding his supper, when he is in the best condition to do good work. But few men, until they have tried it, realize what a vast amount of work can be done in the hour from 7 to 8 p. m., which is so commonly wasted in getting ready to go out. After he has devoted an hour or two to hard study, the workingman should be at home when he finishes, so that he can go to bed, without further fatigue or loss of time or exposure, and secure a good night’s rest.
Difficulties Overcome.	Text-books upon all subjects have served an important purpose in the cause of education. Night schools have aided many to convert their spare moments into knowledge and ultimately into success, but neither of these methods of study nearly fills the educational requirements of workingmen as well as correspondence instruction.
Every Home a School-house.	The correspondence method, calling to its aid the fleet messengers of the postal service, fully meets the peculiar conditions which surround workingmen. Technical education, under the direction of the most competent instructors, is now within the reach of all. Every workingman may make of his

home a schoolhouse, where he can study during his leisure hours and prepare himself for a higher position in life. Every workingman can now qualify for the most responsible duties connected with his trade.

In the opinion of an eminent educator, our School "is the most original agency for technical education ever devised, and portends a time when we will not set off a few of the most fortunate for education, but educate all up to the limits required in the application of the skilled arts." Educational opportunities hitherto unattainable are placed by our method within the reach of all ambitious men, and thousands of workingmen in all parts of the world, representing over two hundred occupations, are taking advantage of these opportunities.

THE BEST METHOD FOR BUSY PEOPLE AND THOSE WHO CANNOT SPARE TIME FROM WORK.

**Spare Moments May
be Utilized.**

Workers and busy people can obtain a knowledge of the theory of their trades by this method. Some, however, hesitate to enroll because they think they have no time to study. To such we say, "There is no business which will not permit a man to give a little time every day to study."

**Notable Instances of
Education
Obtained
in Time
Usually
Wasted.**

Longfellow wrote his translation of "The Inferno" by working in snatches of ten minutes a day while waiting for his coffee to boil. He persisted for years until the work was done. Humboldt had so little time for study that he read in the night or early morning while others were asleep. One of the most noted mathematicians in the United States acquired his education by devoting one hour a day to study. Millard Fillmore never saw a grammar or a geography until he was twenty years of age, yet he became President of the United States. Lincoln, while working at surveying studied law, and while clerking in a general store learned the English branches. Robert Collyer laid the foundation for his education while working at a blacksmith's forge. Watt learned chemistry and mathematics while working at his trade as an instrument maker, and George Stephenson learned arithmetic while running an engine night shifts. He educated himself, and did much of his best work during his spare moments.

**Opportunities for Study
While at
Work.**

Some men have opportunities for study while at work. They should take advantage of such opportunities and plan to get them. Sitting for hours, gazing vacantly at machinery which is doing its work, does not constitute the best service. That man is rendering his employer the best service who, while doing his daily work as he ought, is fitting himself for service of a higher order. The workman who reads and studies most is the most competent, draws the highest pay, and is entitled to and receives the most respect.

**Value of an
Hour.**

But no matter how employed or what may be the rules of employers regarding idle time while on duty, workingmen should remember it has been the men and women who have

been most crowded with work who have done the greatest things in life, and that waste of time for those whose only hope of advancement lies in education means loss of opportunity and loss of hope. The man is yet unborn who rightly measures and fully realizes the value of an hour.

EMPLOYERS, SUPERINTENDENTS AND FOREMEN CAN MAKE UP DEFICIENCIES IN EDUCATION.

Those in Authority Should Know the "Whys and Wherefores." Every employer and every one in a position of authority should know all the details of the business, and should learn the "reasons why" of the duties performed by every employee, so that he can intelligently direct each and show that thorough knowledge of the subject which commands respect. If the plant is extensive, there are probably many trades represented, and the uneducated superintendent who is master of one, when dealing with those of which he is ignorant, must hire foremen who are expert in them, to whose superior knowledge he is compelled to defer—a harmful and humiliating necessity.

They Can Educate Themselves in Our Schools. A superintendent can learn in The International Correspondence Schools the reason for everything going on in the shops under his care. He can thoroughly educate himself in the theory of his business and do his work with little worry to himself and with satisfaction to his employer.

The foreman should make himself as efficient as possible, for if he does not know as much or more than the best-informed man among his subordinates, he occupies an unenviable position. The man who knows more than the boss is too valuable to discharge, and his superior knowledge is always unpleasantly putting itself in evidence. The foreman must lead in all things, but especially in theoretical knowledge. If he cannot read drawings understandingly, he is unable to detect errors or to properly direct work to be made from them.

If They Will Study, Their Success is Assured. The man who can successfully handle a gang of men so as to do satisfactory and economical work is bright and capable. He has the stuff in him for better things; and it only requires well-guided and persistent study to bring it out. He can learn if he will study, and his studies need not interfere with his work.

The correspondence system is preferred by many because they are diffident about exposing their ignorance, as is necessary in a classroom. Many men who could not or would not study when young now occupy positions of responsibility, and are supposed by their employers and associates to have more theoretical knowledge than they possess.

Names of Students Not Published Without Permission. The student of The International Correspondence Schools does not come in contact with other students, and his studies are privately and *confidentially* conducted. We do not publish a list of our students, nor do we publish their names and addresses, unless they voluntarily give us testimonials.

A HELP TO PROFESSIONAL MEN.

All Important Data Epitomized.

It is a common expression with professional men, "Oh, I have got all the authorities on the subject in my bookcase, and can look up the information at any time." Precisely so; the information is in the bookcase, and it remains there, too! Then, when a question arises, "all the authorities" are taken down and dusted, and an hour or two devoted to seeing what the authorities have to say, and other hours are wasted in vain endeavor to decide which authority to act on. It is here the great value of our work comes in. We dust the books and consult all the authorities, so to speak. We epitomize the most important data of the various engineering professions, and present it in clear and concise language to our students.

Successful Men Hard Students.

The most successful professional men are the hardest students. No man can afford to stop studying when he leaves college. When he commences the practice of his profession he finds that he needs to know thoroughly many things which he studied indifferently, and soon forgot, as well as many other things which he did not study at all. To be successful he must study.

There is no safe stopping place; the world continually moves forward, and a man must either keep up with the procession or fall behind. The intense fact of human life is change—movement; a man must move, and unless he moves forward he will move backward. Study is the only sure protection against mental rust and retrogression.

It is the common experience of the young engineer to find himself out of employment. The new enterprise falls through; financial stringency compels a suspension of work; the corporation reorganizes, and the engineering force is succeeded by new appointments; the work is completed, etc.; these are a few of many causes which may throw him out of employment.

Idle Time May be Improved.

But whatever the cause of his enforced idleness, the question arises, what is to be done—what is the best thing to do? The thing which he usually does first is to look for another position. If he is not immediately successful, the next best thing to do is to improve his "idle" time. No time should be wasted. Every day and moment of life should in some way be made to return value. Many an engineer whose professional life has been a series of well-earned triumphs can look back upon unemployed periods, which he was wise enough to take advantage of for needed study, as having greatly contributed to his success.

Engineers Can Take up Other Branches.

Both engineers in general practice and those practicing specialties are the better equipped to make reputation and money, the more they know of all the different branches of engineering, as they are closely allied and frequently enter into the same undertaking. If an engineer, therefore, is thoroughly up in the branch he is practicing, he should occupy his leisure time in studying other branches.

For instance, it often happens that an engineer, following a general practice, finds that a knowledge of bridge designing would be very valuable to him. He is called upon to submit the design for a structure or to decide upon the merits of several designs. Instruction in all the principal engineering specialties can be obtained in The International Correspondence Schools.

Does Not Interfere with Professional Engagements.

The student in these schools pursues his studies without sacrificing any of his working hours. The lesson is studied at the time most convenient to him, and he can carry it with him, so as to make good use of every idle moment.

There are no vacations. Students receive instruction during the entire year.

If anything occurs to make the student interrupt his studies for any length of time, he is allowed the privilege of stopping, and at some future time when he finds it convenient to start at the point he left off, he can do so.

Texts Are Prepared by the Ablest Specialists.

He studies at home, is a class by himself, and is carefully guided by competent teachers. The text-books used are prepared expressly for the School by the ablest specialists, and contain only what is necessary. Students must do thorough work and are expected to ask questions, on blanks sent them, whenever they feel the need of help. Everything is taught from the beginning, and nothing is taken for granted. No extra charge is made, no matter how long it takes the student to finish. Every student is sent, when he enrolls, a complete set of bound volumes of all the Instruction Papers, Question Papers and Drawing Plates used in the course, together with the Tables belonging thereto, and an abstract of all the formulas used in the course, conveniently arranged for reference, all fully indexed and bound in half leather.

APPRENTICES CAN OBTAIN EDUCATIONS.

Difficulty of Getting a Start in Life.

Young men commencing in life labor under great and serious disadvantages. The lack of education in special lines prevents them from making the most of their ability. Their services command little compensation, and their progress is slow.

Life too Short to Learn Everything by Experience.

This is especially true of those who enter the mechanical trades. The graduate of the technical school soon outstrips the man lacking such education, notwithstanding the latter may have the start of many years of practical experience.

How to Get the Desired Education.

How to obtain this education is the question which confronts young men. The great mass cannot afford to stop work or leave home to study. For this class, correspondence instruction solves the problem. It affords men an opportunity to acquire the same purely technical education as offered by our colleges and universities. While maintaining himself, and without leaving home, any young man can qualify himself for positions of trust and responsibility. All that is necessary is that he should make the most of his spare time.

- Course for Apprentice Machinists.** The young man employed in a machine shop can acquire a theoretical knowledge of machine design, and through practical application of what he has learned, eventually become a mechanical engineer.
- Courses for Apprentices to Electrical Trades.** If he is in the employ of an electric light, railway, power or supply manufacturing company, a Mechanical-Electrical, or Electrical Power and Lighting Course, will give him the theoretical knowledge which he must have to become a foreman, superintendent, or manager.
- Courses for Apprentice Steam Engineers, Surveyors, Plumbers, Miners, etc.** Courses in Steam Engineering, Plumbing, Heating and Ventilation, Civil and Mining Engineering and other branches, are designed for the needs of those employed in these lines or who think of entering them. A thorough and practical knowledge of any one of these subjects will prove extremely valuable to its possessor. The Mechanical and Architectural Drawing Courses offer special possibilities. Many young men through taking the one or other have secured positions with mechanical engineers, large iron and steel and other manufacturing companies, in architects' offices, with contractors, builders, etc.
- Promotions Usually Come to Educated Men.** The young man who possesses a thorough knowledge of the theory of any trade or profession has acquired the foundation for a successful career. It will enable him to perform his duties easier, and with greater satisfaction to himself and his employer. His services will become more valuable, and promotion and better pay will follow. Well-directed efforts count.

AN OPEN DOOR TO YOUNG MEN.

- Many Young Men Unfitted for the Battle of Life.** The great majority of young men just leaving grammar and high schools are obliged to commence work at once for a living. Not possessing the means to continue their educations at technical and other schools, and so fit themselves for some particular calling, they turn their attention to the business opportunities that first offer. The engineering professions appeal to but few, for the majority think if they enter these fields, they can never become more than journeymen or subordinates. Accordingly, clerkships in stores and offices are accepted, and as clerks in stores and offices most of them continue to the end of their days. Thousands through this unfortunate error waste their lives, who, had they entered the mechanical trades and engineering professions, might have advanced to important positions.
- Technical Education the Demand of the Times.** The young men of this country need to be awakened to the value of technical education. Great inventions and the successful completion of vast engineering projects form the greater part of the permanent history of the last one hundred years, and for years to come the greatest triumphs of men will be the mastery of the forces of nature and their subjection to the service of the race. A natural question is, who will fill the responsible positions resulting from this development? They must be men of practical experience and technical

Profitable Positions for Those Competent to Fill Them. education. The answer is, they will be the men who now grasp every opportunity for knowledge, and educate themselves. Every young man who aspires to a home of his own, or to the respect and confidence of his employers, or the community in which he lives, *must*, in these times, obtain an education.

In every engineering profession there is plenty of room at the top, and any young man, with fair natural ability, and a capacity for application to study and work, may hope to attain eminence in it. There is no path to human achievement that is barred from the labor and brain of young men.

How to Become a Mechanical, Electrical, Civil, Sanitary or Mining Engineer or an Architect. A young man without means can learn the engineering profession of his choice by becoming an apprentice connected with it, or by entering the drawing-room of an engineering establishment. He can get his technical education from us by the correspondence method, and at the same time maintain himself. This is the best way to learn a profession, because the young man who learns a trade and also a profession is doubly equipped and is bound to succeed.

He can enter a machine shop as an apprentice, and by studying mechanics and mechanical drawing at home, qualify himself as a mechanical engineer.

He can secure employment with an electric light, railway or power, or supply manufacturing company, and through a correspondence course in electricity fit himself for the position of foreman, superintendent or manager.

He can engage as chainman on an engineering corps, and while performing subordinate duties, study to be a civil or mining engineer.

He can learn the carpentering or bricklaying trade, and by taking a course in architecture and architectural drawing, become an architect, contractor, or builder.

Given the Benefit of Others' Experience. Other courses present like opportunities. They are all designed to meet the needs of men who cannot leave home to study, and have only their spare time to devote to it. All that they must know is taught them, and each subject is so presented that they can grasp it. They are given the benefit of the experience of others, with competent Instructors to direct their efforts. A knowledge of the theory of any trade or profession is the foundation for a successful career. This foundation can be obtained through correspondence instruction.

We Can Educate Your Sons. A course in The International Correspondence Schools is, therefore, an "open door" through which the needy but industrious young man can enter the path to success and make for himself a useful and eminent career.

To those engineers, superintendents, foremen and others who have sons whose associations are such as to give them some familiarity with engineering subjects, The International Correspondence Schools are recommended as worthy of investigation and patronage. A course in these Schools will enable a young man to efficiently fill responsible positions years before those who have not had such instruction.

Such men can recollect the difficulty they themselves experienced in mastering the "reason why" of their work, and they must see the great good which their boys will gain by being thoroughly educated in the theory of their vocations.

The instruction we give teaches young men the necessity of study as the opening wedge to advancement, and qualifies them to intelligently read technical books and papers.

To those who go through a course and pass the final examination, Diplomas or Certificates of Proficiency are given.

AN OPPORTUNITY FOR WOMEN.

Courses in Drawing and Designing.

Any woman gifted with artistic taste (what woman is not?) and who is desirous of becoming self-supporting, can qualify herself for pleasant and profitable work in an architectural or mechanical drafting-room by taking an Architectural Drawing and Designing or a Mechanical Drawing Scholarship.

In the best class of architects' offices there is a growing demand for women as designers of interior decorations, and numbers of women are already occupying such positions. Making tracings of either mechanical or architectural drawings is particularly agreeable work for women, and is not difficult to learn.

Business Courses.

Or a woman can take a course in The Correspondence School of Bookkeeping and Stenography, and qualify herself for a business position.

By the correspondence method each one is a class, his or her instruction being carried on privately and independently of any other student. This feature is appreciated by the considerable number of women now enrolled with us, many of whom do not care to have it known that they are pursuing a course of study by correspondence to fit them to earn a livelihood.

FOR THOSE OF LIMITED EDUCATION.

No man should hold back from enrolling because he is a poor writer or speller. Unless he tries to inform himself he will always remain ignorant, and there is no better way of learning to write and spell than to undertake a course of correspondence instruction.

We advertise a thorough plan of education, and nothing can be thorough which does not begin at the beginning.

We Can Teach Any Man Who Will Study.

We guarantee to teach every person who enrolls, provided he will comply with one condition—viz., he must study. If he will study he can learn. We take a great deal of pains with backward students. They cannot exhaust our patience, and our best friends and strongest endorsers are those students with whom we have had the greatest trouble. Men have been taught arithmetic who could not do the simplest problem in addition when they joined the School.

The Dull Student Eventually Completes the Same Studies as the Bright One.

Some students can do their work more quickly than others, because of natural ability, previous education, or more time for study. Suppose two men join on the same day. One is brighter than the other, and is able to write out his answers to the questions in one of the Question Papers in, say, three days, while the other man takes, perhaps, a week. Now, if one student had to wait on another, the brighter student would be delayed in this case, but as every student is a class in himself, each is advanced in the course as fast as his ability will carry him, independently of others. But even if the dull student does progress more slowly, it is only a question of time until he completes the same studies.

Testimonials.

The following are samples of hundreds of testimonials in our possession :

"I practically knew nothing of arithmetic when I started ; now anything ordinary is not difficult for me."

"When I first became a student I was ignorant of arithmetic, but I would not take five times the amount of the course for what I know about it now."

"When I enrolled, all that I could do was simple addition. *I could not do subtraction at all.* I am doing a lot better than I thought I would have done."

"For anyone who, like myself, had no early education, it is one of the best investments to make. The cost is nothing compared to the benefits received in return."

"I was sent to work when I was twelve years of age, and consequently suffered in my education, but thanks to The International Correspondence Schools, I am making up for what I lost."

"My course with you is just like having some one by my side, the instructions are so easily understood. Branches that I thought I would never be able to understand, I have easily mastered."

"It seemed at first almost impossible for me to make any headway, but now, thanks to your kind words of encouragement and admirable method of teaching, I find that whatever lessons you send me are overcome by a little patience."

"I cannot but be very well satisfied with my progress, thanks to your special trouble in regard to me. To those intending to follow any of the courses of your Institution I will most gladly testify to the value of your teaching."

"It is a thing I have been looking for for some time, having been put to work when I was quite young, and, like many others, deprived of early education. My only regret is that I did not hear of the School sooner than I did."

"I took a Scholarship in the English Branches about a year ago, and although I have only used my spare moments for study, the education I have already received through your correspondence method is certainly worth ten times the price I paid for my Scholarship."

Students Encouraged and Assisted.

Our Instructors know that most of those who are enrolled with us begin their studies at the close of a day's weary toil, while the many cares and anxieties of their daily lives are crowding close upon them, and they know, too, if the work which students send in for examination and criticism could but speak, what stories it might tell of hours of patient toil by the light of the midnight lamp. Knowing these things, they throw out many valuable hints adapted to the individual needs of the student, as brought out by his abilities and defects, as shown in his work. All efforts are appreciated, every improvement noted, and the learner encouraged in every way. The student has a conscientious and sympathetic friend to lead him on, and need not fear to *trouble* the Instructors. It is their duty to render all possible assistance.

The student is taught not by text-books, but by Instruction Papers specially prepared by our own Instructors, and purposely written in the plainest, most concise manner possible. All unnecessary matter is omitted. The Instruction Papers are liberally illustrated by our own draftsmen, and in every way special pains are taken with dull students.

Taught Until Qualified to Pass the Final Examination.

We enter into an agreement with each student to keep teaching him until he is qualified to pass the final examination and receive his Diploma or Certificate of Proficiency, no matter how long it may take, nor how often it may be necessary to review.

SUITED TO MEN OF MATURE YEARS.

No One Too Old.

A word to those who think they are too old to learn. It is a fact that a boy's brain does not attain its maximum size until he is about sixteen years of age, and that it does not mature until he is twenty-five. His physical powers do not mature until he is about thirty-five, and eminent authorities believe that a man does not attain his intellectual prime until he is forty-nine or fifty years of age, and that the best years of his life for study or work are after he has passed his fiftieth birthday. Plutarch, the greatest of ancient historians and biographers, did not commence the Latin language until he was almost eighty years old; and Cato was eighty before he took up the Greek language. Isaac Walton wrote some of his best works after he was eighty-five. Hobbes, at eighty-seven years of age, translated the "Iliad."

Mental Power Improves with Age.

Conspicuous Examples.

Bishop John H. Vincent, founder of the Chautauqua movement, has long claimed that the best time for a man to study is from thirty to sixty, and the careers of Gladstone, Bismarck, David Dudley Field, Senators Edmunds and Sherman, and a host of others, prove that the period of highest usefulness may not be reached until a man has passed his seventieth, or his eightieth birthday. With the inspiration of such examples as these, how foolish it is for a man less than fifty years of age to think he is too old to study.

**Average Ages
of Our Stu-
dents.**

The average age of our students is almost twenty-seven. Nearly a third are over thirty, several hundred are over forty, and a number are over sixty years of age. It will thus be seen that age has nothing to do with it. It is merely a question of determination to make something of one's self.

**The Ripened
Intellect
Quickly Com-
prehends.**

The best time to learn the A-B-C's and such simple things as require less the exercise of the reasoning faculties than child-like faith in what we are told, is when we are young, because then there is nothing else we can do. However, a man of forty years can learn to read as easily and as quickly as a child of five. At his time of life his intellect is riper and his mind in better condition to study larger things. *But it is in condition to study anything*, and it is only necessary that he form habits of application and logical thought to successfully study any scientific, technical, or other subject.

**Importance
of the Habit
of Study.**

We wish to place especial emphasis upon the formation of the habit of logical thought—the ability to investigate, to reason, to deduce conclusions—in short, the habit of study. This is the most valuable thing which a man gets in college; it is worth infinitely more to him than all the rules and formulas which he commits to memory. There is no sufficient reason why this habit of study may not be cultivated outside of college and at any time of life. A man should have the benefit of judicious guidance in the selection and arrangement of his studies and be assisted over such difficulties as he may encounter. With such assistance—or, indeed without it—an intelligent man can take up any study, at any time of life, and successfully learn what any man has learned.

A METHOD OF INSTRUCTION ESPECIALLY ADAPTED TO THE NEEDS OF THOSE LIVING IN ISOLATED LOCALITIES.

**Especially
Suited to the
Farmer,
Lumber-
man, Light-
house Keep-
er, Soldier,
Sailor, etc.**

The correspondence method of instruction meets the requirements of farmers and their families, farm hands, young men and others in small villages having few educational advantages, planters, lumbermen, stock raisers, herders and drovers, miners, lighthouse keepers, soldiers, sailors and marines, postmasters, express agents and others who desire to educate themselves, but, by reason of the isolated localities in which they live or the nature of the business in which they are engaged, are prevented from attending school.

Students engaged in these lines of business are studying successfully by our correspondence system. Each student participates equally in the benefits of the Schools, no matter how much he is isolated from the others.

The question is sometimes asked, "How can a man learn without seeing his teacher?" He does not require to see his teacher, for the teacher writes to him, if necessary every day,

giving detailed information by letter in full explanation of every difficulty he meets with in his lessons, and he learns from these and from his Instruction and Question Papers as well as if the teacher were present.

There is no fixed time for the sending of each set of papers by mail, but each student receives another installment of work when he has proven himself proficient in the one he has in hand, and the speed with which he gets through his course depends upon his application to the work.

Proof That We Can Successfully Teach Those Living at a Great Distance. That our Schools fully meet the wants of those living in isolated localities is proven by our large enrollment which represents all parts of the civilized world. We have students in the mining camps of Alaska and the far West, in distant military posts, in the life saving stations of the seacoast and the great lakes and other equally remote sections of the United States.

Students in All Parts of the World. The Schools have many students in foreign lands. In South America, Europe, Asia, Africa, Australia, Tasmania, and New Zealand; wherever the mails go, The International Correspondence Schools are furnishing instruction to many who live in such isolated localities that they could not educate themselves in any other way. See page 18.

Students in Far Away Mining Camps Represented. A student, whose home is about ten thousand miles from Scranton, writes, "Your methods are thorough and are conducive to pleasure as well as knowledge. It is a great advantage to be able to correspond on subjects in which one is desirous of improving." Another writes from a South African mining camp, "I feel that you have an interest in each of your students and cannot speak too highly of your method of instruction by mail."

Many Students in the U. S. Navy. Many students of the Schools in the United States Navy are studying as successfully on shipboard as if they were ashore. Although the men-of-war to which they are attached are sent to all parts of the world, the postal service, through the United States Consulates, enables them to keep in touch with the Instructor, and they receive the same careful attention as their fellow-students on land.

KEYS TO QUESTION PAPERS.

Special Helps. To aid students who live at such great distances from Scranton that the time occupied in sending for and receiving special instruction is unreasonably long, and those whose time, for various reasons, is too limited to enable them to devote more than a few hours each week to study, and others who, for various reasons, would otherwise make slow progress, we have prepared Keys to the Question Papers in all the subjects we teach.

The Keys are not intended to be used except by those who find it difficult to work without them, but if employed judiciously they can be made to save both time and labor without injury to the student.

**How to Use
the Keys.**

The correct way to use Keys is to refer to them only when you feel you cannot master the problems in hand without consuming too much time. Even then they should, except in rare cases, be used only to enable you to grasp the principles underlying the problems. They are merely intended for service in those emergencies when the student feels that he must have help on some particular points, and does not wish to wait until he can write to and receive a letter from us regarding them.

**Every Student
Receives a
Complete
Set of Keys
Free of
Charge.**

The set of bound volumes furnished to the student when he enrolls contains a separate book of Keys, in which are given solutions of all the problems in the Question Papers. Our experience has demonstrated that the great majority of persons who enroll with us are really anxious to educate themselves, and can, therefore, be trusted to use such keys wisely.

REQUIREMENTS FOR ADMISSION.

**No Preparation
Needed
Except Ability
to Read
and Write.**

To enroll, it is not necessary that the students have any previous knowledge of arithmetic or of any of the subjects in the different courses, as *we teach everything from the beginning*. This is one reason of the success of the Schools. Our Instruction Papers are thorough because they bring all subjects up to date, and give the best ideas of the ablest writers. Unlike text-books, they are also thorough because *they take up every subject from the beginning. Thorough in both ways.*

The qualifications necessary to become a student are few. To enable any person to enter the School it is only necessary that he be able to read and write in the English language. With this preparation we can teach arithmetic or drawing, and afterward, in order, algebra, geometry, and trigonometry, and the more advanced subjects.

RULES FOR ENROLLING.

**Application
Form.**

Every student on enrolling must sign an application form which will be supplied to him. In this application he binds himself not to permit any person not a holder of a similar Scholarship to study from the Instruction and Question Papers, Keys or Drawing Plates furnished by the Schools, without permission from the Manager, under penalty of forfeiture of the privileges of the Schools.

We do not object to students showing Instruction or Question Papers, either for the purpose of obtaining assistance from

others, or giving information regarding our method of instruction.

How to Enroll.

To enroll, it is only necessary to fill out the application form and send it to us with the full price of the Scholarship, if you desire to pay in advance, or the first payment if you prefer to pay in installments, and immediately upon receipt of the application properly filled out, accompanied by the money, you will be enrolled as a student and your first work forwarded to you.

Persons May Join at Any Time.

Students may enroll at any time; the only qualification required is ability to read and write, and the only thing necessary to succeed is study. All the subjects we advertise to teach are taught by us with great success.

No reduction in the price of Scholarships is made because the person wishing to enroll is already well informed in one or more of the subjects of the Course in which he desires to enroll.

Certificate of Scholarship is an Agreement to Give Instruction Until Student is Proficient.

We issue to every person who purchases a Scholarship in The International Correspondence Schools, *as soon as we receive full payment*, a Scholarship Certificate similar to that shown in the accompanying full-page illustration. These Certificates are agreements to give instruction to the student until he is proficient in the branches included in his Scholarship and has received his Diploma, no matter how long it may take. He can study when and where he pleases, so that if it is not convenient for him to do the work this year, he can do it next year or the year after. He is thus protected from loss through demands upon his time unforeseen at the time of his enrollment.

Why You Should Enroll Immediately.

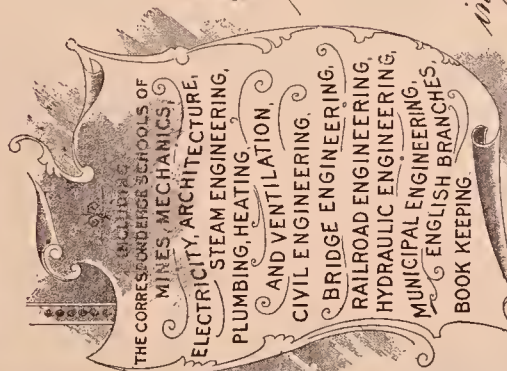
If you are thinking of learning to draw or of studying the theory of your trade, or of preparing yourself to engage in some of the trades or professions the theory of which we teach, do not put the matter off. Enroll without delay. If you postpone for six months commencing to study, it will be just that much longer before you will profit by your education. If you do not make a decision now, you may not do so at all. Procrastination may result in great loss to you, because in this country, in this age of invention, industrial progress, and rapid increase of wealth, every man blessed with good health and a fair technical education can safely calculate upon achieving business success.

Scholarships Transferable.

We do not cancel Scholarships or refund money paid for them.

It is understood that if at any time a student desires to stop studying he has the right to sell his Scholarship or give it to some other person, and that it is transferable. The charge for transferring Scholarships is \$1.00, and the charge to the person receiving the Scholarship, for instruction in the subjects in which the student has received instruction, does not exceed \$2.50 per subject, except where the average price of the subjects, as found by dividing the price of the Scholarship by the number of subjects included therein, is greater than \$2.50.

Class Letter and Number _____



THE International Correspondence Schools. SCRANTON, PENNSYLVANIA.

This is to Certify that Mr. *John Smith*
of New York P.O. State of *Ohio* has purchased one

A Complete Civil Engineering
SECTION A R S H I P

in The International Correspondence Schools, entitling
him to instruction, subject to the conditions stated in his application
for the same, until he has completed the course of study and been
awarded a Diploma.

Witness the Seal of The Colliery Engineer Company and
the Signatures of the President and Secretary, Date _____ 189

Sanley P. Allen Secretary
Rufus L. Foster President

ORDER OF WORK.

**Drawing May
be Taken in
Connection
with Other
Studies.**

Students are required to take up and complete their studies in the order given in the schedule of studies in the Circulars of Information, except that they can take up drawing in connection with the other work. When there are good reasons for departing from this rule, permission is given the student to do so. We find from experience that it is best for students to do the work in regular order; even if they are well informed in some of the subjects when they commence, a review is always advantageous.

THE EXPENSES CONNECTED WITH A COURSE.

**An Education
Within the
Reach of All.**

The cost of education in our Schools is much less than that of similar instruction obtained elsewhere in the world. It is so small that even the most indigent can hope sometime to be in a position to study with us.

To obtain a technical education in a regular school or college costs a sum which to the majority of people is a small fortune. It includes board for three or four years, and is so great that 99 per cent. of those who would be benefited by technical education and who are anxious to get it, can never hope to command it for the purpose.

**Only Four
Items of Ex-
penditure.**

In our Schools the expenses, other than the prices of the Scholarships, are limited to the cost of paper on which to write the answers to the questions, the postage to send these answers to the Schools, and, in some of the courses, a small amount of inexpensive instruments and apparatus.

THE PRICES OF SCHOLARSHIPS.

**The Courses
Cheap at Ten
Times the
Price.**

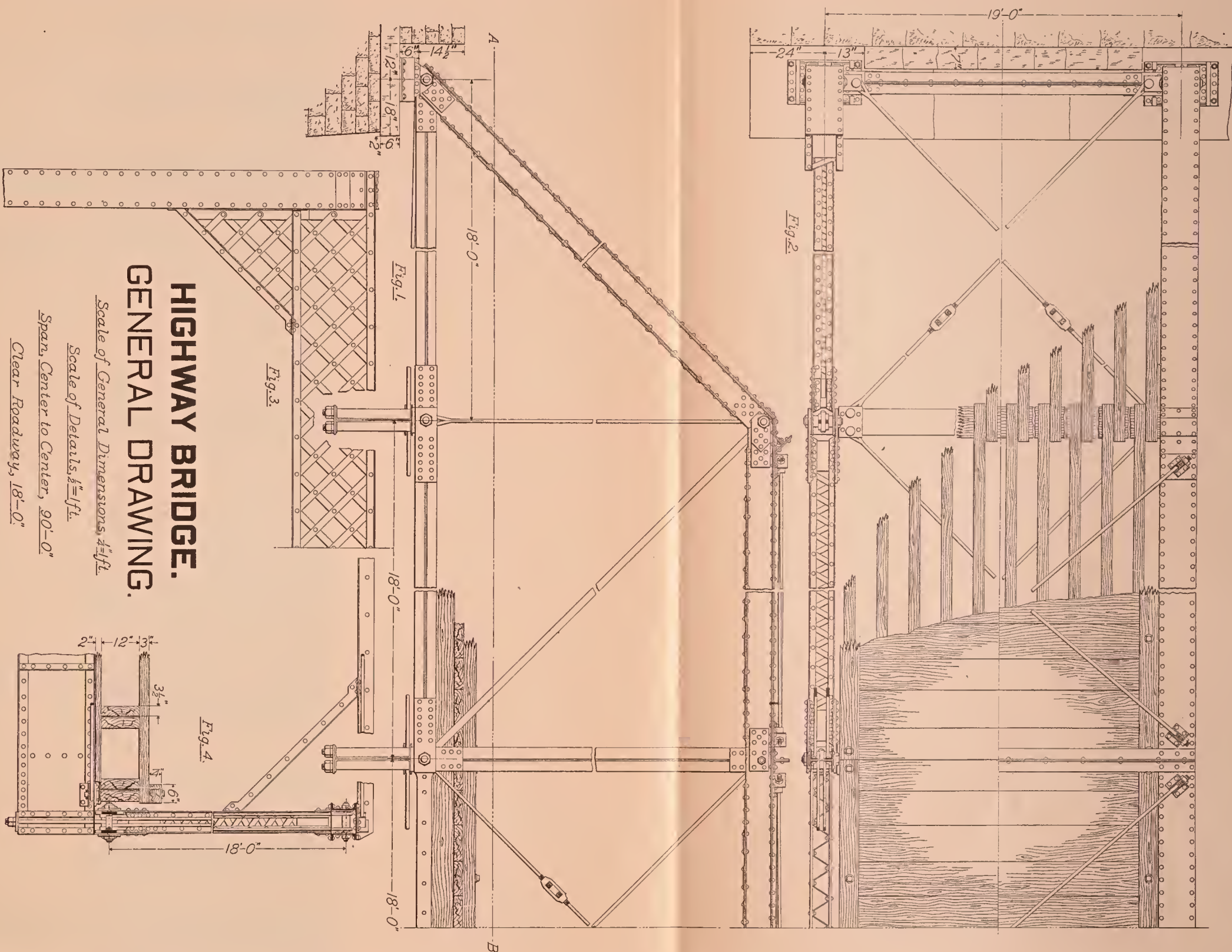
The Scholarships are cheap at ten times the price asked, but the prices are purposely made low because the classes whom the Schools are intended to reach cannot pay more. The cost of a Scholarship in The International Correspondence Schools is even less than the cost of the text-books which a student must have in pursuing the same studies in a regular technical school.

**Payment May
be Made by
Install-
ments.**

For the convenience of those who wish to pay for the Scholarships in small amounts, we accept payment in monthly installments, and *it is understood that if purchasers of Scholarships on the installment plan cannot pay their installments promptly, on account of unavoidable causes, such as ill health, loss of employment, etc., upon making a written request to the Manager they are to receive such extension of time as may be necessary.*

Students in our Schools are not obliged to buy any books whatever. The Instruction Papers are complete text-books.

Every pupil who buys a Scholarship is entitled to the full benefits of the School until proficiency is gained in the subjects undertaken, and he has passed the final examination and obtained a Diploma or Certificate of Proficiency, no matter how long it may take him.



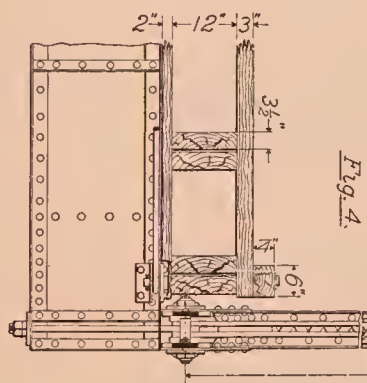
HIGHWAY BRIDGE. **GENERAL DRAWING.**

Scale of General Dimensions, $\frac{1}{4}$ "=1 ft.

Scale of Details, $\frac{1}{8}$ "=1 ft.

Span, Center to Center, 90'-0"

Clear Roadway, 18'-0"



JUNE 25, 1893.

DRAWING PLATE NO. XVIII.

JOHN SMITH, CLASS No 4529.

Accompanying Instruction Paper on Mechanical Drawing of The Correspondence School of Civil Engineering. (Reduced.)

THE COST OF PAPER ON WHICH TO WRITE THE ANSWERS TO THE QUESTIONS.

Students Must Use Light Paper. The student supplies himself with foolscap paper on which to do his work. As the price of the postage increases with the weight of the paper, it is advantageous alike to him and to ourselves for him to use as light paper as possible.

Prices of T. S. Co. Paper. The Technical Supply Company, Scranton, Pa., will furnish good light linen paper, 13x8½ inches, at the following rates :

100 sheets by mail (postage paid)	\$0.45
250 " " " " " "	1.15
500 " " " " " "	2.25
100 " " "express (purchaser to pay expressage)	0.30
250 " " " " " " " "	0.80
500 " " " " " " " "	1.50

Students can order directly from them or through us, *but they are not required to do so*. If they buy elsewhere they are requested to buy light paper of good quality, as it makes a considerable difference in the postage.

THE COST OF OUTFITS.

Unless they already have similar instruments and apparatus, students in some of our chemical and mining courses require chemical outfits and students in courses which include instruction in drawing need a drawing outfit such as is described in our Circulars of Information. The prices of these outfits range from \$5 up. The goods comprising them are of good quality, and the price given is lower than they can be bought for from retailers of such goods.

May be Purchased Elsewhere. Students are not required to purchase these goods of The Technical Supply Company or through us. They can buy them where they see fit. But intending purchasers will find that both in price and quality The Technical Supply Company can do better than local dealers.

THE POSTAGE TO SEND THE ANSWERS TO THE SCHOOL.

The work of the students is sent to us in sealed envelopes (which we furnish) as "first-class mail matter," the rate for which is two cents for each ounce or fraction thereof, prepaid. It is a violation of the postal laws to send it as "third-class matter."

Average Cost for Postage. The postage bill of the average student is about one-tenth of the price of his Scholarship.

The School pays the postage on the Instruction and Question Papers, Drawing Plates and all other communications sent to the student, and furnishes him with envelopes and information blanks free of charge.

DIPLOMAS AND CERTIFICATES OF PROFICIENCY

- What the Diplomas Are.** Diplomas and Certificates of Proficiency are issued to students completing all the subjects of the courses who pass the final examination. These Diplomas and Certificates are the legally authenticated declarations of the Instructors of the Schools that the holders thereof have successfully completed the study of the subjects named, and have satisfied them of their proficiency therein. They do not carry with them degrees.
- How Granted.** They are granted on final examination papers answered by the student after he has completed his studies, before a witness appointed by the Principal, if he considers it necessary to appoint one. The student's answers to the final examination papers become the property of the Schools and will not be returned.
- High Standard Maintained.** A high standard is maintained for the Diplomas and Certificates of Proficiency of The International Correspondence Schools by only issuing them to those who have faithfully passed through the courses and proved by the final examination that they are entitled to possess them.
- The Final Examination.** We do not bind ourselves in our Scholarship Certificate to give a Diploma or Certificate of Proficiency when the student has passed through all the subjects of a particular course of study, but we do bind ourselves to instruct until the student is qualified to receive the Diploma or Certificate. If a student after completing a course is found, on final examination, not to understand the subjects well enough to qualify him to receive a Diploma or Certificate, he is required to review the whole course or the branches in which he is deficient, and he is kept reviewing until he satisfies the Instructors that he has a good knowledge of all the subjects in the course.
- Under no circumstances are they issued to undeserving persons; so that to hold one is of itself evidence that the holder has been a faithful student and possesses the education claimed.

BOUND VOLUMES.

- Students Can Obtain at Once Complete Bound Sets of All Papers.** Realizing the almost inestimable value which our Instruction Papers, Question Papers, Drawing Plates and Keys possess to those who have studied them, and the importance of having them in such a shape that they can be referred to or reviewed at any time, we have made arrangements to have them revised, reprinted, and bound into volumes convenient to handle, and which can be used and preserved for a life-time. These Volumes, all fully indexed and bound in half leather, and constituting a complete duplicate set of all the Papers sent to the student from the time he enrolls until he finishes his course, are now sent to the student free of charge, as soon as he enrolls.
- Superior Examples of the Printers' Art.** Although the expense connected with the preparation of these Bound Volumes has been very great, we have allowed nothing to stand in the way of our turning out examples of text-book work that have never been excelled. In every way

—illustrations, binding, paper, typography, printing, etc.—these bound volumes are unapproached. The type was selected with great care. The paper has a smooth finish, and is of that delightful cream color which is so easy on the eyes when reading by artificial light.

Indexing.

The indexes are very full, so that the reader can find almost instantly any definition, rule, description, etc. that he wishes. Whenever it has been deemed advisable, the same reference has been indexed in several places. Thus, "centrifugal force" may be found under "C" or under "F"; and "mechanical equivalent of heat" under "M," under "E," or under "H." Great attention has been given to every detail that would be likely to benefit the reader in any way.

Everything Necessary to a Complete Engineering Education.

Any one who owns a set of these bound volumes can thoroughly inform himself in regard to the trade or profession treated of in them, provided he can read and write the English language.

Arithmetic is included in each course and it commences at the very beginning; the digits are named and defined, and instructions are given for reading numbers and writing them. The sections on square and cube root and on ratio and proportion are very full and complete; they contain more practical information and the explanations are clearer than can be found in any other arithmetic. One or more examples, together with their solutions, are given immediately after each rule, in order to show the application of the rule, and numerous "examples for practice" are scattered throughout the entire paper.

Features of the Arithmetic.

Whenever possible, these examples have been made to correspond with those which would be likely to arise in actual practice; that is, instead of making the examples relate to apples, cows, sheep, etc., the aim has been in the engineering courses to make them apply to engines, pumps, economizers, and other details. Moreover, our arithmetic is strictly up-to-date, and any one, no matter how much he may know of the subject, will obtain new and valuable ideas by carefully reading it through. It may likewise be added that in the engineering courses only those portions of arithmetic are given which the student really needs in order to intelligently study the remainder of his course, and to read and comprehend the arithmetical work that occurs in text-books relating to engineering.

Subjects Follow in Logical Order.

The other subjects then follow in rotation, and in such manner that no knowledge of any succeeding subject is required in order that any part of the subject being studied may be clearly understood. Each subject is treated as fully as is necessary to give the student a thorough working knowledge, both of the theory and practice. Constant references are made to the preceding subjects, and many of the examples are so stated that the student is obliged to use rules, formulas, principles, etc. that he has already learned when studying a preceding subject, in order to solve these examples. By this means he keeps himself constantly in touch with what he has previously learned, and the constant application of what he already knows to the subject he is studying not only shows him the value of the knowledge already gained, but it also impresses that

Helpful References to Preliminary Subjects.

knowledge more firmly upon his mind. The writers know from actual experience just what portions of the text are likely to prove most troublesome to one who is studying the subject for the first time, and every effort has been made to state the facts in language which shall be comprehensible to the reader.

Simplicity.

Writers of text-books which are intended to be used in schools and colleges understand the subject so well themselves that they frequently forget that what is so clear and apparent to them may not be so to others; as a consequence, their explanations of some of the simpler facts—which are of vital importance later—are not adequate to impress the full meaning upon the mind of the reader. Any one who has ever studied a mathematical or technical work will readily acknowledge that it is impossible to obtain a clear understanding of the subject unless the reader fully comprehends the meaning of the definitions, laws, axioms, and rules, for it is from these as the roots that the tree is developed. Our writers are fully conscious of this fact, and they have endeavored, assisted by constant references to preceding paragraphs and citations of facts of every-day life, to lead the student's thoughts into such channels that he will readily perceive the truths that he is endeavoring to learn—and to understand them.

Conciseness.

The explanations are not so full, however, as to react on the student's mind and tend to confuse him by their very wealth of detail; indeed, we make the claim that we cover more ground by our method in a smaller number of pages than any other text-books published, not requiring a knowledge of the higher mathematics. One reason for this is that different subjects are written up especially for the courses in which they are included; and we are thus enabled to eliminate matters that other authors are obliged to insert, as their books must be more general than ours.

**Practical
Presenta-
tion of Sub-
jects.**

Any one wishing to review subjects which he has previously studied, but is now "rusty" in, will find our Bound Volumes of great benefit to him. The practical way in which subjects are presented will at once appeal to his sense of "fitness of things," and he will obtain a better idea of the real value of theory, as applied to the trades and engineering, than he ever had before. Many statements which used to puzzle him, or which he comprehended only after much study and hard thinking, he will find explained in such a manner that it will really be a pleasure to review his studies. For example: the subject of resolution of forces, as usually treated in works on mechanics, is not sufficiently clear to give the student a thorough understanding of its leading principle. Thus, the reader is told that if he wishes to find the effect which a given force will produce in any required direction, he must resolve the given force into two components, one of which shall be parallel to the required direction, and the other perpendicular to it.

**Principles
Fully Ex-
plained.**

The reasons for drawing the components in this arbitrary manner are so obvious to the author that he overlooks the fact that they may trouble a beginner exceedingly; and even if he did think of it, he would regard the matter as not worth mentioning, because a little independent thought on the part

of the reader would show him the reasons for so drawing them. We, however, do not regard the matter in that light; we think that anything relating to principles, particularly principles that are used as frequently as that of resolution of forces, should be explained as fully and as simply as possible. While we endeavor to train the student to think for himself, we do it by causing him to think out new ways of applying the principles which he has learned—not by trying to muddle him in regard to the principles themselves.

**Our Writers
Have Special
Facilities.**

In this connection, it will be well to note one great advantage that we possess over all other writers of text-books. Our many thousands of students comprise men of every walk of life; men of considerable education and men of no education; men who can reason well and men who cannot; and, as a consequence, we receive many letters containing suggestions and inquiries every day. From these letters we are enabled to determine the particular points that are most troublesome to our students; and when we get out a new edition of an Instruction Paper, we endeavor to remedy all the defects and to clear up troublesome statements, explanations, etc. that may have occurred in the first edition. The third edition goes through the same process, if it is deemed necessary. Many Papers in our bound volumes have been through from two to five editions and as many revisions, and their adaptability to all classes of readers ought, therefore, to be apparent. When an ordinary text-book is *revised*, the revision is usually accomplished by adding more to it—not by straightening out the text, which is very rarely changed, for the authors have no such means as we have of finding out the difficulties that beset their readers. Then, too, as the ordinary text-book is very rarely intended for self-instruction, the author might not deem it advisable to alter the original text, preferring to leave it to the teacher to explain any difficulty that may arise.

**Each Revision a Step
Forward.**

**Continuous
Numbering
of Pages,
Articles and
Figures.**

In these Bound Volumes the article numbers, page numbers, figure numbers, formula numbers, etc. are continuous, thus making all references easy to look up, and preventing the many mistakes that would be likely to occur if the article numbers, figure numbers, etc. began with 1 in each volume. At the back of each volume, the Question Papers that accompany the Instruction Papers in that volume are placed in regular order. The questions are also numbered continuously throughout the course.

**Arrangement of the
Drawing
Plates, Etc.**

We have paid particular attention to the arrangement of the instructions for drawing and the drawing plates. In order to obviate the inconvenience arising from the presence of folding plates in a book of this kind, this volume differs in form from that of other volumes. Its size is $11\frac{1}{4}'' \times 14\frac{1}{2}''$ (opening to $11\frac{1}{4}'' \times 29''$), the drawing plates being 12 inches long between the border-lines. This has enabled us to place the description of each plate opposite the plate referred to, thus avoiding any turning of leaves when comparing the text with the plates. To one who has been accustomed to the ordinary works on drawing, this volume will prove a revelation. The plates are exact reproductions of actual drawings, by the photo-zinc

process, and are slightly reduced, in order to prevent the student from copying the drawing by the use of his spacing dividers, or other similar device. As examples of the draftsman's art, these plates cannot be surpassed, and we have never seen them equalled; the beautiful evenness of the sectioning, width of lines, and shading acts as an inspiration and an incentive to the student. A very complete index is also furnished. It may here be remarked that the majority of the plates are drawings of machine details taken from blue-prints.

**A Volume
of Tables,
Rules, and
Formulas.**

**Nothing Sim-
ilar Ever
Before Pub-
lished.**

**Answers to
Questions.**

In each set there is a volume containing all the principal tables, rules, and formulas that are given in the other volumes. Each letter used in a formula is defined immediately above it. The formula number and the number of the article in which it occurs are placed after, and a heading stating the purpose of the formula or rule is placed directly above. The reader will at once perceive what a valuable aid this volume will prove to him. Nothing similar to it has ever before been published. As the book is small, it can be carried about without inconvenience, and it will be found an almost daily aid in actual work by persons engaged in engineering and mechanical pursuits. All the calculations have been made and verified by our Instructors, men of large practical experience in the subjects treated of, and they have produced a volume, the uses of which will be best appreciated by those having it close at hand in the drafting-room, the machine shop, the engine room, or wherever work is done, the accuracy and rapidity of which may be increased by the use of labor-saving computation.

The last volume in each set contains the answers to the questions and the solutions to the examples in the Instruction Papers of the Course, to be found at the end of the other volumes. These Keys are written with the utmost care and thoroughness, combined with our usual simplicity of statement, and are illustrated, where the subject-matter requires it, with drawings and diagrams in the text and upon large inserted folded sheets of superior paper.

The Bound Volumes are only issued to enrolled students. We send them to students as soon as they enroll. If they have paid for their Scholarships in full, the Bound Volumes will belong to them, but if not, the title of the Volumes will remain in us until the Scholarship is paid in full.

We have secured, for the benefit of our students, low rates from the express companies on the Bound Volumes. To secure these reduced rates, students residing on the Pacific Coast must pay the express charges in advance. Before shipment we will therefore notify students residing in those States what the express charges will be, and they can make payment in advance, through us, if they so desire.

THE CORRESPONDENCE SCHOOL OF CIVIL ENGINEERING.

CIVIL ENGINEERING.

Advantages of Education in Civil En- gineering.

In constructing permanent highways of commerce across desert, swamp, and plain, along hillsides, through mountains and over rivers, and in turning the courses of streams away from their natural beds into channels where they will minister to the necessities of man and contribute to the wealth and happiness of communities, civil engineering deals more directly with the forces of nature than any other profession. To successfully grapple with these forces one must have a knowledge of nature's laws. Such knowledge cannot be obtained in a day or in a year; it is the work of a lifetime. Hence, in this profession, of all others, the man who would win success must avail himself of the experience of other men, or, in other words, obtain an education. The unsatisfactory, expensive and even disastrous effects of work planned by uneducated engineers, such as railway lines imperfectly located, the health and safety of towns and cities jeopardized by imperfect systems of water supply and drainage, and dreadful disasters caused by the giving way of bridges, caving-in of tunnels, bursting of dams, etc., prove this statement.

The following extract from "The Railroad Gazette" of November 29th, 1895, is an excellent illustration of the great advantage of an engineering education to the man who wishes to rise in the profession of civil engineering:

Responsible Positions Held by Graduates of Cornell University.

"Professor Fuertes, of Cornell, has recently undertaken to show what has become of 386 graduates of the College of Civil Engineering of Cornell University. He finds among these 8 presidents of railroads, 8 presidents of industrial corporations, 17 city engineers, 35 engineers in practice, 5 consulting engineers, 9 contractors, and 37 chief engineers, managers, or superintendents of municipal or corporate works or manufacturing establishments. He finds 22 professors in colleges and 15 associate professors and instructors. Of certain groups containing 111 of these alumni nearly all are assistant chief engineers or assistant engineers for manufactories, municipal works, and corporations. There is another group of 52, one-half of whom are mining, mechanical, or electrical engineers, and the others architects, shipbuilders, and patent lawyers. Finally there is a group of 22 of these alumni, containing clergymen, merchants, bankers, farmers, and, we grieve to say, 2 politicians. It is true that the list compiled by Professor Fuertes accounts for only 341 out of 386. Of the others 28 have died and 17 had not been heard from when the list was made up. * * * The New

**Alumni of
Rensselaer
Polytechnic
Institute in
Charge of
Engineering
Operations.**

York 'Sun' says, 'Not long ago a pamphlet was published giving partial records of the graduates of the Rensselaer Polytechnic Institute, bringing the story down to the end of 1892. The first graduating class was in 1826, when 10 men were graduated. The total down to the end of 1892 was about 1000; we have not the exact figures. Of these gentlemen 69 had held the position of chief engineer; 34 were known to have been presidents of corporations; 121 had been vice-presidents, general managers, or superintendents of railroads, bridge companies, steel and iron works, mining companies, coal companies, water works, canals, etc.; 56 had been professors and assistant professors in the higher institutions of learning in this and other countries, besides whom many others had served in colleges and technical schools as teachers in various capacities. It was ascertained that graduates of this institution had held positions as presidents, vice-presidents, and engineers, managers, or superintendents of railroads aggregating over 109,000 miles in North America, while many miles of railroad had been built by them in South America, Europe, and Japan.

"Before December, 1892, 190 graduates of the R. P. I. had become members of the American Society of Civil Engineers, 146 of them in the highest grade of membership—that is, 11 per cent of the membership of the society was made up of the alumni of the R. P. I. While membership in the American Society of Civil Engineers is not an absolute test of character or attainments, it is presumptive evidence that the man holding it stands considerably above the mean plane of human success.

**Graduates of
Stevens In-
stitute of
Technology
Are Equally
Successful.**

"The 'Sun' also gives the following information, furnished by President Morton for the Stevens Institute: 'Since 1875, 551 men have graduated there with this record: superintendents and managers of the entire business of important departments of machine shops and like engineering works, 148; consulting engineers, carrying on professional work on their own account, 54; professors in technical or engineering colleges or schools, 30; assistant engineers or superintendents in workshops and like mechanical establishments, 55; presidents, vice-presidents, secretaries, and treasurers of manufacturing companies, 16; employed in designing, drawing, and superintending construction of machinery, 103; patent lawyers and solicitors, agents and inspectors for manufacturing companies, 36; superintendents of motive power on important railroads, 8; in employ of foreign corporations, 13; editors of engineering journals, 6; architects, 3; chemists, 4; unknown or not classified, 50; deceased, 25.

**No Training
More Sure to
Make a Suc-
cessful Man.**

"Of course the engineer has had a hard time in the last two or three years. Great crises like that through which we have been passing affect him especially, and the civil engineer, like the members of any other profession with which we have come in contact, likes to grumble about his own hard times in the world. The chances are that the next doctor or lawyer or architect whom you meet on the street will tell you that his profession is overcrowded, and advise you strongly to put your boy into some other calling, and statistics show that about 90 per

cent. of those who go into business fail. Therefore, the engineer has no monopoly of hard times and precarious livelihood, and we still insist that there is no other training that is so sure to make a successful and useful and happy man."

Mr. Gladstone has expressed the opinion that one of the most prominent features of the history of the nineteenth century will always be "the increased facilities of communication between man and man all over the world." The historian of the future will place the civil engineer and the statesman upon the same pedestal.

The Correspondence School of Civil Engineering.

Provides the Technical Education Necessary to Successful Professional Work.

Instruction in Mathematics and Physics.

The Correspondence School of Civil Engineering is intended to provide a means by which those already engaged in occupations leading up to this profession, and those who wish to enter such occupations may qualify for advancement. It is also intended to provide practicing engineers with opportunities to review what they have already learned, or to study special branches of the profession in which they lack knowledge. The instruction in The Correspondence School of Civil Engineering is sufficiently advanced and comprehensive to ensure to the graduate the technical training necessary to the successful prosecution of his professional work. The student is first, as in all our courses, given thorough instruction in practical mathematics and physics, for, as Dr. Thomas M. Drown, President of Lehigh University, has well said: "There is no system of engineering education, however thoughtfully and ingeniously devised, which can do away with the drill in fundamental mathematical subjects. The workman must have fitting tools for his work and must thoroughly understand their use. The engineer must be fully grounded in his mathematics, physics, and mechanics, so that his mind works in mathematical channels without effort. This is his necessary equipment as an engineer; but in acquiring this mathematical facility his mind becomes, at the same time, trained in accurate, logical thinking, and his whole mental and moral fiber becomes strengthened. Specious reasoning repels him, for the quickened intellect detects fallacy. The engineer thus gains in his mathematical training the first qualification of an educated man." Upon this foundation the student commences the erection of what he may make, if he will, a magnificent civil engineering education.

CIVIL ENGINEERING SCHOLARSHIP.

The following is a list of the subjects included in the Complete Civil Engineering Scholarship:

Subjects Included in the Complete Civil Engineering Scholarship.

Arithmetic, algebra, logarithms, geometry and trigonometry, elementary mechanics, hydromechanics, pneumatics, heat, geometrical drawing, mechanical drawing, elementary graphical statics, strength of materials, analysis of stresses, proportioning the material, details of construction, details, bills and estimates, steam and steam engines, steam boilers, locomotives, descriptive astronomy, surveying, land surveying, mapping, railroad location, railroad construction, track work, railroad

structures, elementary chemistry, economic geology of coal and metals, blowpiping, mineralogy, drainage, sewerage, streets and highways, paving, water wheels, hydraulic machinery, water-works, dynamos and motors, electric lighting, electric railways.

CIVIL ENGINEERS SHOULD STUDY.

Must Constantly Review or Forget Much of Value. Probably but few civil engineers ever engage in any one enterprise which calls for the exercise of all the professional knowledge they possess. If employed at one line of work, the engineer can scarcely fail to forget, unless he spends his spare time in study, much that would be of value and even necessary to the proper performance of his duties under other circumstances. Next year, or perhaps to-morrow, circumstances may change, and he may be required to make use of the very things

Must Keep Abreast of the Times. which he has neglected or forgotten. Again, no man can win the highest success in any line of business who does not study constantly to keep abreast with the progress of the times. With the civil engineer this is especially true, for his professional duties necessitate an acquaintance with such a wide range of subjects, while change and improvement are going on so continually in every direction, that he must study or be left behind. This, then, is another reason why the practicing engineer should study.

Changed Conditions Require Improved Methods of Construction. It is not enough that the engineer be familiar with the methods of construction in vogue twenty years ago. What would have been acceptable then is now, because of changed economic conditions, impossible or, at least, not expedient. The engineer of to-day must so plan and construct his work that it will satisfactorily fulfil all requirements at the least possible cost, and, at the same time, compare favorably with the most modern and progressive work planned by other engineers, otherwise the investment will not pay, and men, nowadays, who invest capital in great engineering enterprises are far more in search of dividends than of glory. For this reason, also, the practicing engineer must study.

Advantages of Correspondence Instruction. But it is difficult to pursue alone and unaided a course of systematic study; few men can successfully do it. Our correspondence system exactly meets the wants of all who are willing to devote their leisure time to study. Furthermore, the student's work is all in writing, and every fault and weakness is thereby made apparent, only to be corrected, while at the same time his mind is helped to retain the facts and principles studied. The student thus learns to be correct, explicit, and concise—qualities of great value to the civil engineer.

DIVISIONS OF CIVIL ENGINEERING.

Advice to Intending Students. Whatever his professional duties or aspirations may be, the student of engineering who enrolls in The Correspondence School of Civil Engineering will find it to his advantage to take the complete Civil Engineering Scholarship, if it is at all pos-

**Specializa-
tion the Ten-
dency of the
Times.**

sible for him to do so, because the broader his education as an engineer, the more successful he will be in his work. But this is an age of specialization, and most of our students can spare neither the time nor the money to study branches not directly related to the particular specialty they wish to follow. A generation ago a civil engineer was likely to be called upon at one time to construct a railway, at another to build a canal, install a system of water-works, erect a building, or design a piece of machinery, or even open a mine. Such titles as railroad engineering, bridge engineering, hydraulic engineering, sanitary engineering, municipal engineering, and electrical engineering were unknown. The titles mechanical engineering and mining engineering were little used, and even to this day mining engineering is included in the civil engineering course of one of the best known technical institutions in the United States.

Mr. Thomas Curtis Clarke, President of the American Society of Civil Engineers, is quoted in "The Railroad Gazette" of July 10th, 1896, as having said: "Civil Engineering is divided into structural, mechanical, electrical, metallurgical, hydraulic, mining, agricultural, chemical, sanitary, municipal, highway and railway engineering. These classes are again subdivided—as hydraulic engineering into canal, harbor, water supply, power, storage and irrigation engineering. Railway engineering is divided into bridge, foundation, track, signaling, locomotive and car engineering."

**Many Stu-
dents Study
a Special
Branch of
Civil Engi-
neering.**

But no one man is now expected to compete successfully with other men in all these various fields. Indeed, it has been found impossible for one man to combine within himself the detail knowledge necessary to practice all these branches with entire success. One branch alone is almost sufficient to make a life study, and the engineering specialist of to-day finds himself busily enough occupied in keeping abreast of the times. Many of the most successful engineers confine themselves to a single line of work. Most of our students know this, and for this reason, and because of lack of time and means, confine their studies within a comparatively narrow compass. Moreover, many of our students are civil engineers, surveyors, draftsmen, etc., already educated in certain branches, who desire to gain a knowledge of one or more additional branches of engineering, or to review some branch previously studied.

**We Provide
Instruction
in Special-
ties.**

While, therefore, we would advise all who are able to do so to take the complete Civil Engineering Scholarship, we recognize the demand for instruction in specialties and therefore provide courses in railroad engineering, surveying and mapping, bridge engineering, municipal engineering and hydraulic engineering, which, for convenience, are described separately in the following pages under their respective titles. All of the subjects taught in these several scholarships are included in the complete Civil Engineering Course, which embraces all of the subjects taught in The Correspondence School of Civil Engineering.

RAILROAD ENGINEERING SCHOLARSHIP.

A Desirable Profession for Ambitious Men.

Railroad Construction Sure to Increase.

The profession of railroad engineering offers many opportunities for ambitious men. The rapid growth in population, the opening up and settlement of new sections of the country, the continued development of sparsely populated districts, and the consequent increase in productive and consumptive capacities, require the building of many new lines of railroad and the extension of old lines, to provide means of transportation and communication. While, in periods of financial depression, investors shrink from new railroad enterprises, yet such cessations in railroad construction as the one we have recently witnessed are sure to be of only temporary duration, and some of the ablest political economists and other advanced thinkers hold that within the next 15 years not less than 100,000 additional miles of railroad will be required in the United States. Railroads are being and will be constructed in large numbers in Asia, Africa and South America, and these, too, will give employment to many railroad engineers. The Trans-Siberian railroad and the French railroad across the Sahara desert are movements in this direction. Large railway undertakings are expected soon to be commenced in China. The construction of new railroads creates a demand for railroad engineers.

Care and Improvement of Railways in Operation Adds to the Demand for Educated Engineers.

The care and improvement of railroads already in operation also require the services of a large number of engineers. Many thousands of miles of railroad in the United States have been so hastily built that within the next generation the reduction of operating expenses will necessitate their practical reconstruction. In Europe, conditions have prevailed which have made it possible to construct the work at first in a manner more nearly suited to the ultimate requirements of the traffic. In European countries, curves of less radius than 1,000 feet are rare; in America, curves three times as sharp are often met with. With them, grades of 60 feet to a mile are considered unusually heavy; we have many grades much heavier. Their lines have been built through populous districts; many of ours have been constructed for hundreds of miles through uninhabited country and dreary wilderness. Their low rate of interest on capital enabled them to build tunnels and make deep cuts at once where needed, no matter how great the expense, while we were obliged to avoid them by the use of curves, loops and all kinds of cheaper and more or less temporary expedients; and to the lasting credit of American engineers it must be said that they have overcome greater difficulties in the face of the necessity to economize at every point than the engineers of any other country. The extent of their success is shown by the fact that while speeds of 45 and 50 miles an hour are common in this country, the fastest express train on the continent of Europe, i. e., from Paris to Nice, averages but 39 miles per hour.

Improvement of Old Roads.

But the conditions of twenty years ago are rapidly changing; tunnels are now being driven and bridges built where they will materially ease the grades and straighten the lines.

Heavy cuts and fills, which, at the time the roads were constructed, were avoided because of the great expense, are now often made for the purpose of shortening and improving the lines to meet the demands of the greatly increased traffic.

Subjects Included in our Railroad Engineering Scholarship.

Our Course in Railroad Engineering embraces arithmetic, algebra, logarithms, geometry and trigonometry, elementary mechanics, hydromechanics, pneumatics, geometrical drawing, mechanical drawing, strength of materials, surveying, land surveying, mapping, railroad location, railroad construction, track-work and railroad structures, and constitutes a complete course of instruction in the survey, location, and construction of railroads.

How the Subjects Are Treated.

The organization, equipment, and duties of surveying, leveling, and topographical parties are treated in a thorough and practical manner, and the Course includes all the instruction on surveying and mapping of our Surveying and Mapping Scholarship. The principles of railroad location are treated in a plain, clear, and practical manner; the treatment of this subject includes a consideration of the economics of location, such as requirements of traffic, economical location as to grades and curves, operating expenses, value of improvements as to existing lines, best locations for towns, villages, etc. The subject of railroad construction is treated thoroughly and quite in detail; it includes such matters as staking out the cross-sections, calculating the earthwork, estimating the cost, measurement of work, methods of construction, etc., giving much information that is of great value. The course also embraces the subject of track-work, including track-laying; surfacing; the laying out of frogs, switches, turnouts and crossings; calculation of earthwork; making estimates of cost, and many other matters of great practical importance and of especial value to those engaged in the maintenance of way departments of railroads. The construction of foundations, buildings, bridges, turntables, gates, semaphores and other railroad structures also receives such attention as to give the railroad engineer the knowledge of these subjects necessary to his complete educational equipment.

Nothing has been left undone to make the course of the greatest value, not only to those who contemplate becoming railroad engineers, but also to those already engaged in the practice of civil engineering.

FOR ROADMASTERS, TRACK FOREMEN, AND OTHER RAILROAD EMPLOYEES.

Men in the Maintenance of Way Departments of Railroads Can Obtain Promotion Through Study.

Although many of the men employed in the maintenance of way departments of our larger railroads are educated engineers, many are not. Such men are in the direct line of promotion, and it is mainly due to lack of education that their abilities are not oftener recognized by promotion to more responsible and lucrative positions. They are in position to obtain valuable experience in the handling of men and in the practical details of work, both of which go far toward fitting them for advancement.

The one obstacle to be overcome, and which they alone can surmount, may be removed by study; and this obstacle, though their greatest hindrance, is the one most easily removed, did they but appreciate the fact. We can help them remove it. Many of these men are in the habit of thinking, because they did not have opportunities of obtaining educations when young, that the door of knowledge is permanently closed to them and they must be contented to see the more lucrative positions filled by men who have had the advantages of early education. This is all a mistake. All ambitious, intelligent men have the stuff in them for better things; and it only requires well-guided and persistent study to bring it out. They can learn by our method if they will study, and their studies can be so conducted as not to interfere with their daily occupations.

**Importance
of a Knowl-
edge of Engi-
neering
Principles.**

Roadmasters and their assistants, track foremen and other employees, especially those employed in maintenance of way departments, should study railroad engineering. If they do not understand the engineering principles upon which their work is based they labor at a disadvantage. Nothing will so broaden and enlarge their spheres of usefulness and increase the value of their services as will systematic study of those principles, and they do themselves and their families great injustice if they neglect to pursue such courses of study, provided they can do so.

**A Letter of
Encourage-
ment.**

In the "Engineering News" of May 6th, 1897, was printed a copy of a letter written by Mr. J. F. Wallace, Chief Engineer of the Illinois Central Railroad, to a young college man who applied to him for a position. As the letter is "to the point" and is full of encouragement for men employed in the maintenance of way departments of railroads, we reprint a portion of it. Mr. Wallace said: "The engineering department of the Illinois Central Railroad has also charge of the maintenance department of ways and structures. In this maintenance department I have 14 roadmasters, whose rate of compensation per year is from \$2,000 for the first class to \$1,800 for the second class and \$1,500 for the third class. They each have charge of from 200 to 400 miles of track. Under the roadmasters are the supervisors, who have charge of about 100 miles of track each, and receive from \$100 to \$125 per month. The section foremen under the supervisors have 6 or 7 miles of track to look after. Out of the 14 roadmasters there are 8 who had received an engineering education and had had considerable practice as civil engineers before they accepted their present positions. Some of the supervisors are also engineers. It is my desire to fill these places, as far as possible, with competent, educated engineers, provided I can secure men who, in addition to their technical training, have a practical knowledge of the details of track-work and experience in handling men, and have acquired their experience on the Illinois Central Railroad. The opportunities for the average civil engineer to acquire this intimate knowledge of track-work are limited, and as a consequence men of this class with these qualifications are scarce.

**Advantages
of Entering
the Track
Department.**

"I would suggest to you and your friend the advisability of entering our track department. As apprentices in this line working on a section, you would receive from \$1 to \$1.25 per day, depending on the part of the line where you might be employed. If you are bright, intelligent and industrious, and not afraid of hard manual labor, in the course of a year you should have acquired that knowledge of track and the details of road-way maintenance which would render you competent to handle a section as foreman. The pay of section foremen ranges from \$45 to \$50 per month, according to location and importance of work. After one or two years' experience as section foreman you would probably be qualified for promotion to the grade of supervisor, and from that to roadmaster. Roadmasters, in common with others, are in line for promotion to the higher ranks of railroad service. This is the only branch of engineering work that I know of which is not crowded with experienced and competent men, and is a field of work which I would recommend to young men who have received an engineering education and who desire a definite line of special action which will give constant employment, with chances of speedy promotion for competent men."

SURVEYING AND MAPPING SCHOLARSHIP.

**Subjects In-
cluded in our
Surveying
and Mapping
Scholarship.**

The Course in Surveying and Mapping embraces arithmetic, use of letters in algebraic formulas, geometry and trigonometry, logarithms, geometrical drawing, surveying, land surveying and mapping. The instruction in surveying includes surveying with both compass and the transit, land as well as railroad; leveling; topographical and hydrographical surveying. It does not include mine surveying. The various subjects are so fully and clearly treated in the Instruction Papers as to make it possible for any one who will apply himself to study to thoroughly qualify for practical work in both field and office. We are able to teach the subject of surveying by mail with the greatest success.

**How the Use
of the In-
struments is
Taught.**

Great attention is paid to the details of the adjustments of instruments and the operations involved in surveying. The use of the chain, tape, compass, transit, and level is explained in clear, concise language, and the whole subject is illustrated by cuts and diagrams so fully as to make it readily grasped by men of ordinary intelligence.

In railroad surveying the theory of simple and compound (sometimes called transition, easement and spiral) curves, turn-outs, etc. is thoroughly taught; the student is also given instructions in the use of the stadia, sextant, solar compass and plane table.

This Course is intended for engineers' and surveyors' assistants and all persons interested in any branch of surveying other than mine surveying.

FOR ENGINEERS' AND SURVEYORS' ASSISTANTS IN DIFFERENT CAPACITIES, ETC.

An Opportunity for Engineers' and Surveyors' Assistants.

Engineers' and surveyors' assistants in different capacities, such as transitmen, levelmen, draftsmen, rodmen, flagmen, chainmen, axemen, stake drivers, etc., should embrace the opportunity we offer of learning the principles of the work in which they are engaged.

Puts Them in Line for Advancement.

Usually the surveyor's assistants are young men who have had but little previous training in this particular work. This is certainly nothing against them, for whatever a man's vocation and however proficient he may afterwards become in it, there must necessarily be a beginning—a time when his experience is small and his knowledge limited. On the other hand it is very much to the advantage of such young men to be engaged in work where intelligence and integrity are the essential requirements and are sure of ready recognition. They stand direct in the line of advancement.

Promotion Follows Self-Improvement.

Promotions to more responsible and lucrative positions usually follow in the natural order of things, if they become capable of taking advantage of the opportunities that arise—of filling satisfactorily the positions which open to them, *but they must be found capable*. They are getting valuable practical experience and what they most need in addition is theoretical knowledge and training, and this can only be obtained by study:

Suited to Men Who Can Only Devote Spare Time to Study.

The subjects necessary for them to learn are difficult to master unaided, though when placed before them in a proper manner by competent instructors, the difficulties are usually overcome quite easily.

To attend the usual technical school is out of the question, for that necessitates giving up their position; but there is a way open to them and to the young men who are similarly situated, and that is our School.

There are very few young men working as surveyors' assistants who would not like to become surveyors, but they think such an attainment beyond their reach and therefore do not make the effort.

Instruction Papers Prepared by Practical Men.

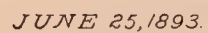
This course teaches such young men just what they require. They study at home during leisure hours and have the assistance of competent Instructors. The Instruction Papers are prepared by practical men and teach what can be practically applied.

The chief difference between the surveyor and his subordinate is a difference in education. Education, which is the necessary means of intelligent growth or development, is now open to all men by our efficient method of home instruction, which ambitious students can pursue with us without loss of time from work.

Many Able Engineers Started at the Bottom.

Many an engineer who to-day stands high in his profession began his career as rodman, chainman, flagman, or, possibly, axeman on a railroad survey. In many cases this has been the absolute beginning, without any previous engineering

Scale 1" = 200ft.



DRAWING PLATE NO. VI.

Accompanying Instruction Paper on Mapping of The Correspondence School of Civil Engineering. (Reduced.)

**How They
Worked
Their Way
Up.**

knowledge, training, or experience. The history of his career is usually somewhat as follows : He had an ordinary, common-school education. Circumstances arose by which he obtained a position in a railroad surveying party—as rodman, perhaps. He was bright and ambitious, and soon began to pick up ideas—a general knowledge of the instruments and methods, and some fragmentary knowledge of the underlying principles. He asked questions ; he won the friendship of one of the engineers, who recognized his intelligence and gave him valuable assistance ; he learned the use of the instrument and something, perhaps, of its adjustments. The demand arose for more assistant engineers, and recognizing his intelligence the chief engineer decided to trust him to run an instrument. He did the work carefully and well, learning his instrument thoroughly as he used it. He improved every possible opportunity to study, and his career has since been a constant succession of advancements. This is no exaggerated picture ; it is a brief description of what not uncommonly occurs, and the picture is exemplified in the lives of many successful engineers.

**Draftsmen
Can Become
Railroad En-
gineers.**

Young men engaged as draftsmen in engineers' offices have excellent opportunities for obtaining valuable knowledge pertaining to the practical methods of surveying. They become familiar with the methods of keeping the notes and of plotting the work from the notes, and learn something of the general routine of the work. Occasionally they are called upon to assist in making surveys and thus learn field work and the use of the instruments. With proper theoretical training they are in a position to become very capable surveyors. The opportunity for obtaining the necessary theoretical training in regard to the principles involved in the work is available through our method of instruction.

BRIDGE ENGINEERING SCHOLARSHIP.

**Development
of the Steel
Bridge.**

The development of the steel bridge has been a gradual one. First the wooden bridge ; then the bridge constructed partly of iron and partly of wood (still to be found in many sections of the country, and very economical where suitable wood can be obtained cheaply) ; then the bridge constructed of wrought iron, with cast iron for the members subjected only to crushing strains ; then the bridge constructed wholly of wrought iron, and finally the various forms of steel trusses. At first steel was used only for certain portions of bridges. Now its use in bridge structures is so general that the all-steel bridge is the rule and those of other materials are the exceptions ; probably three-fourths of all the bridges now in use are iron or steel. For this reason, and because of the extent of the subject, our course treats chiefly of the metal construction, but the construction of one of wood or any other material is based upon the same principles and becomes a simple matter to a person who understands the design of a metal bridge. The strains and stresses are the same ; the only difference is in the proportioning of the materials.

**The Simple
Truss the
Standard
Form.**

Again, although there are many forms of metal bridges, such as the simple truss, cantilever, arch, suspension, etc., yet, with the partial exception of the suspension bridge, they all depend upon the same principle, namely, the truss element, for their stability. By far the greater number of bridges constructed in this country are truss bridges. Most forms of bridges are modifications of the simple truss, and if a young engineer learns to design a truss bridge well he need have little difficulty in the design of more complicated structures, for such designs usually involve merely a more extended application of the principles embodied in the simple truss. Our Bridge Engineering Course, therefore, gives especial attention to simple truss bridges, and particularly to the Pratt truss, which is, beyond question, the most popular as well as the most economical form of all-metal bridge.

**Subjects In-
cluded in our
Bridge En-
gineering
Scholarship.**

The Course embraces instruction in arithmetic, algebra, logarithms, geometry and trigonometry, elementary mechanics, hydromechanics, pneumatics, geometrical drawing, mechanical drawing, elementary graphical statics, strength of materials, analysis of stresses, proportioning the material, details of construction, details, bills, and estimates.

**Practice in
Bridge Draft-
ing.**

Mechanical drawing is the first subject in which the student begins to study anything directly relating to bridges. After passing through the elementary principles of general constructive drawing, he is taught to make working drawings, including the various members and details of a truss bridge; he thus becomes familiar with the general form of bridges and bridge members, and the manner of representing them.

**Order in
Which Sub-
jects Are
Taught.**

He next studies elementary graphical statics and the analysis of stresses, in which he learns to analyze graphically the stresses in structures he has already drawn. The student himself analyzes the stresses in the trusses of several bridges which are chosen as examples. Different methods of graphical analysis are learned. The next subject taken up is the strength of materials; he first studies the general features of the subject, then learns to make practical applications of the knowledge in proportioning the material for the different members of bridges; he himself proportions the material for bridges for which he has previously determined the stresses; he becomes competent to make the stress sheets for bridges, and himself makes the complete stress sheets for several bridges. Next he studies the details of the construction; he learns to design the practical details and connections of the members and to make the shop drawings from which the bridge is to be constructed.

**Complete,
Concise,
Systematic,
Thorough.**

The instruction is thoroughly systematic; the student is taught one thing at a time and is led on, step by step, until he is competent to make the complete design for a bridge. Finally he receives instruction in details, bills, and estimates, teaching him how to make the shop lists, orders for material, shipping bills, erection diagrams, and estimates of weight for bridges, all of which are of great importance and value to the young man who expects to become a competent bridge engineer.

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- Graphical Method of Analysis.** In our Bridge Engineering Course we teach the application of the graphical method of analysis only. Both the graphical and the analytical methods are good. It is difficult to say which is the better, but in order to avoid the confusion which may be created in the mind of the student by studying both methods and because the time which our students can devote to study is limited, we teach but one method. We selected the graphical method not because we believed it to be better than the method by moments, but because it appeared to be more progressive.
- Points in Its Favor.** It is certainly becoming more and more popular, and its applications are being constantly expanded and extended. Graphical methods of analysis seem to be the methods of the future, and it is probable that they will be continually improved. We therefore believe that the student of bridge engineering who thoroughly understands graphical methods of analysis is not only equipped for the present, but is in a position to keep abreast with the progress of the future.
- Strength of Materials.** After the student has become well grounded in the study of elementary graphical statics he is taught, under the head of strength of materials, the weights, composition, and characteristics of the materials of engineering construction. The principles of and the various kinds of stresses; the behavior of materials under stress; the strength of beams, columns, shafts, ropes, etc. are also included under this head.
- Analysis of Stresses.** In analysis of stresses the principle of the truss element and the loads which may come on a bridge are studied, and the stresses on the various members due to the loads are analyzed for various forms of trusses. This subject is treated quite fully, the most modern graphical methods are taught, and some methods of analysis not elsewhere published are given.
- Proportioning the Material.** Proportioning the material treats of the manner of determining the sections and proportions required for the various members of the truss. It teaches how to easily and quickly determine the approximate radius of gyration for different forms of sections, and how to use compression formulas. The effect of the stresses due to live load, dead load, and wind load are thoroughly discussed. It also treats of the fatigue of metals and makes a comparison of the conditions of various specifications.
- Details of Construction, Bills, and Estimates.** Under the head of details of construction the student is taught how to proportion the constructive details and connections of the various members of a bridge and how to analyze the strength of the same. The paper on details, bills, and estimates, which is the final Paper of the Course, supplements the instruction given in the Paper on details of construction and treats also the shop lists, bills of material, estimates of weight, shipping bills, etc.
- The Bridge Engineering Course is practical and systematic and adapted to the requirements of any one who may desire to prosecute the study. The subject is treated plainly but very thoroughly; the language is simple and the mathematics easily

understood, so that the subject can be successfully studied by those not familiar with advanced mathematics. It is believed that this simplicity will not be objectionable to those who have studied the higher mathematics. The course is well adapted to the requirements of young men seeking employment in bridge-construction offices.

**For Whom
the Course is
Designed.**

It is intended for civil engineers, supervisors of bridges, bridge builders, bridge office employees, draftsmen, template makers, inspectors, boiler-makers, structural iron workers, and the young men who wish to become bridge engineers and draftsmen.

FOR CIVIL ENGINEERS.

**Why Civil En-
gineers Find
a Knowledge
of Bridge
Engineering
Valuable.**

A knowledge of bridge engineering is of great advantage to the civil engineer following a general practice, for he may be frequently called upon to make the design for a bridge, or to give advice concerning it, or to pass upon the designs submitted in competition by bridge-constructing companies. As the country grows in wealth and railroads and highways multiply, the number of bridges which require to be built every year increases at a rapid rate. Fords are superseded by strong and graceful structures of steel, and the larger streams are spanned at more frequent intervals. Viaducts are built to cross ravines, many of them having paved roadways high in air, thus avoiding the long, difficult and unsightly inclines on either side which are otherwise necessary. Adjoining cities, separated by bodies of water, are connected to their mutual advantage. In short, the advantages of bridges, and the fact that many bridges are being built, will be evident to any one who will merely look about him. The increasing frequency of accidents due to falls of bridges used by electric railroads, has called public attention to the fact that bridges which are safe for ordinary wagon loads are not always safe for electric traction. The increasing size and weight of cars and of loads carried are making it imperative that competent bridge engineers should be engaged to superintend the erection and maintenance of bridges on trolley lines. A knowledge of bridge designing, sufficient to enable the civil engineer to efficiently decide upon the merits of the designs submitted for a structure, or of designing it himself, can be readily obtained through our Bridge Engineering Course.

**FOR BRIDGE ERECTORS, SUPERVISORS OF BRIDGES,
AND BRIDGE INSPECTORS.**

**Bridge Erec-
tors, Etc.
Can Qualify
to Check Er-
rors of De-
signers and
to Make
Plans and
Estimates.**

The duties of bridge erectors, supervisors of bridges, and bridge inspectors are such as to give them and their assistants a practical knowledge of bridge design and construction. As a usual thing the bridge engineer after having finished the design of a bridge seldom visits the bridge site. If the bridge has been properly designed and constructed there is seldom reason why he should; but if, owing to some error in the design or shop work, some one or more members are incorrectly proportioned or constructed, it is of the greatest impor-

tance that the erector be able to detect the error and remedy it, when possible to do so in the field. This he can do if he possesses a theoretical as well as practical knowledge of bridge engineering. The bridge erector who can furnish designs and estimates for his own bridges is doubly equipped for securing and retaining success. Supervisors of bridges and bridge inspectors occupy much the same position. Upon them fall the duties of bridge inspection, and sometimes of the erection also. They are peculiarly well situated to take our Bridge Engineering Course to advantage, and if they do so, make investments which cannot fail to yield excellent returns to themselves and families.

FOR BRIDGE DRAFTSMEN AND OTHER EMPLOYEES OF BRIDGE COMPANIES.

A Magnificent Opportunity for Bridge Draftsmen.

Young men who are employed as draftsmen and in other capacities in bridge offices should enroll in this Course. A young man so employed, according to the position he fills, secures valuable experience in practical construction and becomes familiar with shop work, or obtains practical knowledge in designing details and making shop drawings. If, in addition, he will study the principles—the theory of stresses, the strength of materials, and the method of proportioning the material, all thoroughly covered in this Course—he can make himself a competent bridge engineer. No young man, especially no draftsman, should neglect such an opportunity of improving his condition.

FOR TEMPLATE MAKERS.

Can Become Bridge Draftsmen or Bridge Engineers.

There are many reasons why a template maker in a bridge shop should make a very capable bridge office draftsman, or even a bridge engineer; and there is no real obstacle in the way to prevent him from becoming one or the other, or both—unless it be a lack of ambition and energy. From the shop drawings he makes the templates from which to lay out the work for the shop; he necessarily becomes familiar with all the details of the drawings and obtains practical knowledge concerning the designing, and, what is of great value, learns how to so arrange the details as to be convenient for the shop construction. He has only to learn to draw and to make the calculations for proportioning the material for the details to resist the stresses, in order to become an efficient draftsman.

FOR STRUCTURAL IRON WORKERS.

How Structural Iron Workers Will be Benefited.

Structural iron workers, and all engaged in similar occupations, can take our Bridge Engineering Course to advantage. Their practical experience enables them to derive the greatest possible benefit from the studies included in it. They are constantly meeting with problems in their work which a knowledge of strength of materials, analysis of stresses, etc. will enable them to overcome. In no other way can they more quickly increase their earning capacity than by devoting a portion of their idle time to study.

FOR YOUNG MEN WHO DESIRE TO BECOME BRIDGE ENGINEERS OR DRAFTSMEN.

An Opportunity for Young Men.

There are many young men whom circumstances prevent from leaving home to obtain a technical education, but who possess the commendable ambition to better their condition in life. Such a young man's inclination may be toward bridge engineering, and as a step in that direction he may desire to obtain a position as draftsman in a bridge office. Unless he has had some previous training or has friends to intercede for him, this is not easily done. But if he has had a reasonable amount of experience, such a position is not usually difficult to obtain, for there is usually a good demand for bridge and structural draftsmen.

Our Course in Bridge Engineering offers the best opportunity for the study of this specialty that is open to such a young man without requiring his leaving home. It is thorough and practical, and while taking it he can support himself.

MUNICIPAL ENGINEERING SCHOLARSHIP.

Development of Municipal Engineering.

One of the most remarkable characteristics of the age is the large increase in urban populations. This movement, so noticeable in the United States—where for several decades in many of the Eastern agricultural districts the population has remained stationary or has decreased and the growth of the towns and cities has been rapid and great—is not confined to this country. In Germany nearly all the large cities have grown in the last twenty years in greater ratio than those of the United States. This concentration of population in towns and cities has brought about a wonderful development in all lines of civil engineering related to municipal improvement. Street railways and paved streets; sewers; garbage crematories; sewage-purification plants, and other methods of utilizing or disposing of sewage; hydraulic enterprises to obtain supplies of water for power, fire, and domestic purposes; bridges and viaducts, etc. are in common use and constant process of construction, and the demand for such engineering works is certain to greatly increase.

Paving.

Any one of the subjects just named is almost a profession by itself. The subject of pavements alone involves a large amount of special knowledge. The judicious selection of a proper pavement to meet the requirements of the traffic on a given street, the establishing of a proper grade and cross-section for the pavement, the preparation of the foundation, and, finally, the laying of the surface material, are all matters of great importance, requiring special knowledge and trained judgment.

Sewerage.

The subject of sewerage is of great and growing importance. The advantages of sewerage and its beneficial effects upon the health of communities have been fully demonstrated and are now well known. It has been repeatedly shown that the

health conditions of towns and cities have been greatly improved, and the death-rate of the inhabitants correspondingly lowered by the introduction of sewerage systems. In many cities where epidemics of typhoid fever and similar diseases had been of frequent occurrence, the epidemics ceased upon the construction of efficient sewerage systems, accompanied by a supply of pure water. Indeed, the salutary effect of properly designed systems of sewerage upon the health of the inhabitants of cities is no longer a matter of conjecture ; it is a well-established fact. At the present time, the question is not whether it is advantageous to build sewers, but *how* to build them so as to most efficiently and economically meet the requirements.

Sewage Purification.

But the construction of sewerage systems has, of itself, opened up a new field of sanitary science. It has been well demonstrated that the most efficient means of removing sewage is by what is known as the water-carriage system, that is, by means of water conveyed through underground pipes and conduits. But the sewage so removed must be discharged somewhere and, in most cases, where not possible to discharge it in tide-water, it has been discharged into streams and watercourses, in many cases so polluting the streams as to seriously affect the supply of pure water. This condition is becoming more and more common, and, in some parts of the country, the danger threatening the water supply is causing grave apprehension. In seeking to remedy the evil, sanitary engineers have conceived the idea of purifying the sewage before discharging it into the watercourses. To this end sewage-purification plants have been constructed, and are being operated with considerable success. Indeed, so high a degree of purification has been attained in some cases, that the discharged effluent has, upon analysis, been found purer than the average supply of drinking water ; and some even believe that the processes will ultimately become so perfected that the effluent discharged from treated sewage will be sufficiently pure to be safe to be used for domestic purposes. As to this we do not venture an opinion ; but we do know that the science of sewage purification is rapidly developing, that its importance is great, and that the conditions are such as to constantly increase the demand for it.

Municipal Surveying.

The greatly increased valuation of urban property, due to the concentration of population in towns and cities, has created a demand for more accurate and systematic surveys, both in regard to existing property lines and in the extension of streets and the laying out of new additions. Those conditions call for improved methods of measurements in the surveys, for more permanent monuments to perpetuate the surveys, and for more accurate and detailed descriptions in the records. Engineers who have had experience in surveying valuable property in the densely built-up portions of large cities are well aware of the great difficulties often involved, and of the high degree of knowledge, skill, and judgment, as well as the patient and painstaking labor, necessary to successfully overcome them.

**Demand for
Municipal
Engineers.**

**Educational
Needs of the
Average City
Engineer.**

**How This
Education
Can be Ob-
tained.**

**What the
Course in
Municipal
Engineering
Includes.**

Those are a few of the many things with which the municipal engineer has to do. They are matters of importance and must be dealt with intelligently. No man is capable of dealing successfully with matters of such great importance unless he has previously had efficient training along these special lines. These and similar conditions have resulted in enlarging and extending the field for trained municipal engineers to an extent far beyond what would have been thought probable, or even possible, twenty-five years ago; and the demand for qualified municipal engineers is rapidly increasing. Many of the engineers of our cities, as well as their assistants, are men of insufficient special and theoretical training for the important work in which they are engaged, who have been given their responsible positions because they come nearer to meeting the requirements than others available. It is sometimes the case that the city engineer is a surveyor who has "grown up with the town." Perhaps he assisted in making the first surveys, or has practiced as a surveyor in the city for some years, aiding in the extension of streets, in the subdivision of new additions, the laying out of parks, etc., and has acquired much valuable knowledge concerning the street and property lines and similar matters. He is, however, constantly meeting with engineering problems which he does not fully understand and the underlying principles of which he does not fully grasp or appreciate. When such is the case he visits some consulting engineer of repute and obtains advice, or goes ahead on his own responsibility and obtains experience—at the expense of the city. Such a "professional" career is unsafe. Sometimes the end is disastrous. The sure protection to the young city engineer who desires to retain his position and the respect and confidence of his fellow townsmen consists in an education in the theory of his profession. Such education can be obtained in our Municipal Engineering Scholarship, which includes instruction in the following subjects: arithmetic, algebra, logarithms, geometry and trigonometry, elementary mechanics, hydromechanics, pneumatics, geometrical drawing, mechanical drawing, strength of materials, surveying, land surveying, mapping, drainage, sewerage, streets and highways, paving.

After studying the seven preparatory subjects of mathematics and physics, the student is given a thorough drill in drawing. He then studies the subject of strength of materials as relating to the materials used in engineering constructions; then studies the subjects of surveying and mapping, substantially as taught in the Surveying and Mapping Course. He then begins the subject of drainage. This subject, as relating to municipal engineering, is practically the subject of *storm-water sewerage*, one of the most complex and least understood of the subjects with which the municipal engineer has to deal. The subject is treated in a simple manner and upon a rational basis. The rate of rainfall is discussed and a rational formula deduced for the storm-water effluent. Other formulas for the effluent are given, and the practice in various cities noticed. The usual hydraulic formulas are then given and the student is taught to determine the required dimensions of the sewers.

Both circular and egg-shaped sewers are treated. The elements of egg-shaped, as well as circular, sewers are given quite completely, and equivalent values for circular and egg-shaped sewers are stated.

Under the head of Sewerage is studied the subject of sewerage proper, that is, the removal of domestic and factory sewage. The subject of water consumption is first considered, and is taken as a basis for indicating the quantity of sewage to be produced by what is known as the *separate system*. The application of hydraulic formulas for determining the required dimensions of the sewers is then given. The minimum permissible grades and grades for uniform velocity are discussed. The preliminary surveys and determination of the best routes, the laying out and the construction of the sewers, and the inspection and required qualities of the material are quite thoroughly treated. Different forms of sewerage systems, sewer ventilation and flushing, different methods of sewage disposal, the cost of sewers and sewer assessments are also discussed.

Streets and Highways.

The subject of streets and highways is next studied. Highways within the limits of municipalities are commonly known as streets and avenues. In order to present the subject in its simplest possible aspect, however, the location, construction and maintenance of country highways are first treated quite thoroughly. In cities the conditions are much more complex, on account of the closer limitations, the widely varying interests involved and the requirements for better thoroughfares, all tending to render the problem more complicated. The student is taught how to lay out streets, the most advantageous forms and sizes of blocks and lots and the proper arrangement of streets and avenues. The width of streets and width and cross-section of roadways are discussed; a general formula for the crown of roadways is stated and different methods of effecting the crown are given. Such matters as gutters, curbs, footwalks and street lawns receive consideration, and the complex problem of street intersections is discussed at some length. Considerable information is given concerning street grades, grade records, city base and bench marks, marking and perpetuating street and property lines, setting, witnessing, and recording monuments, and, finally, the encroachment of lines, statutes of limitation, and duties of municipal surveyors in regard to encroachments.

Introductory to the subject of pavements, the principles of tractive resistance, as relating to different kinds of roadway surfaces, are taught. The comparative economic values of different pavements are discussed; for the purposes of comparison, the economic values are also expressed by formulas, and examples are given. The materials used in different pavements are then described, and the requisite properties of the materials are given. The methods of constructing the various kinds of pavements in common use are then described quite in detail. All important matters, from the foundation to the finished roadway pavement, are treated quite thoroughly, and the treatment also includes sidewalk, crosswalk and gutter pavements.

HYDRAULIC ENGINEERING SCHOLARSHIP.

Hydraulic Power.

For centuries past, and for all time to come, in all probability, water power has been and will be one of the agencies most commonly employed to lighten labor. For a time it looked as though steam, because of the readiness with which it might be obtained in almost any locality, might displace water as a motive power, but the discovery of electricity and its practical application in the industrial sciences as a cheap and efficient means for the transmission of power has wrought another great change, and one which the ambitious civil engineer cannot afford to overlook.

Its Use Increased by Electric Transmission.

Water power is, of itself, portable in only a very limited sense—and then only at a very heavy outlay for canals and canal maintenance—but it has been utilized by mankind from the earliest times, and manufacturing communities in all ages have built in localities near the source of this cheap power, the site of the water power being often unhealthy, inaccessible, and otherwise inconvenient. Electric power transmission has so changed the conditions that they can locate now wherever they wish.

Utilization of Waterfalls.

There are many installations for the carriage of hundreds of horsepower to distances of ten and fifteen miles. Within the last few years the transmission of power over one hundred miles has been successfully accomplished in Europe. The utilization of a portion of the enormous supply of energy at Niagara Falls and its transmission to adjacent cities and the surrounding country has been for some years a matter of widespread public interest.

Water Powers Are Being Purchased for Development.

Water powers are being bought up in every direction by capitalists who see that the work of the future will be done largely through the medium of electricity, and who realize that this subtle force can be produced at an almost nominal expense by the utilization of water power now going to waste.

It will at once be seen what a splendid field is now opening up to the hydraulic engineer in the building of hydraulic engineering works for power purposes.

Public Water Supply of Cities and Towns.

Hundreds and thousands of cities and towns in this and other countries, which are now without a general water supply, will surely at an early date appropriate this blessing and necessity of civilization. Though the time-honored well, with its "old oaken bucket" or more modern pump, is a convenient, and usually safe, source of water supply in sparsely populated rural districts, it is a very dangerous source of supply in densely populated cities. The contamination of well water, due to the pollution of the soil necessarily resulting from a dense population, is a great and exceedingly dangerous menace to the health of those who use such water. Typhoid fevers and similar complaints are in most cases traceable to impure drinking water. In past years these facts have not been sufficiently understood, but they are now becoming quite generally known, and most cities and towns are providing public water systems for the purpose of obtaining a pure water supply. Every town

will in time put in water-works to secure pure water and modern conveniences. The maintenance of those works already established gives employment to many hydraulic engineers, and the number will rapidly increase as the country grows in wealth and population. The protection which a constant water supply affords against fires, the convenience which it provides for the disposal of sewage, and the public health which it preserves by its freedom from pollution, render a general water supply a necessity of every civilized community. Wherever this necessity is felt and met, an opportunity is offered to the hydraulic engineer to establish reputation and make money.

Water Transportation.

Water transportation is cheaper than railroad transportation, and where the time of transit is not the chief consideration freight naturally flows to the least expensive route. Of late years there has been a marked revival of canal and river improvement to provide new highways of trade. Carrying freight in large steel barges in tow of tugboats is the cheapest mode of transportation known. It meets the requirements of maximum bulk at minimum cost, and such projects as the locks in the Columbia River, the enlargement of the New York canals, the improvement of the Mississippi River, the construction of new harbor channels, of the Chicago Drainage Canal, and the restoration of the Dismal Swamp Canal mark the era of return to the ancient and cheaper methods of transportation by water.

Irrigation Engineering.

There is also a wide and growing field for engineering experts in the science and art of irrigation. There is abundance of good land, good climate and temperature in the arid regions of the West. In Colorado, California and other sections within the past few years, by means of canals and ditches and other works such as properly come within the province of the hydraulic engineer, land formerly unproductive and otherwise valueless, to the extent of 5,000,000 acres, has been brought under successful cultivation, and is now producing luxuriant vegetation. These irrigated lands, once quite unproductive, are now among the most productive agricultural lands in the country. The yield of crops, depending upon certain and systematic irrigation instead of uncertain and capricious rainfall, is much surer than in localities where irrigation is not practiced. The reclamation of these vast sections of country involves large expenditures of money (the works already constructed for this purpose having cost not less than \$30,000,000), and call for a high order of engineering ability. More than 10,000 miles of irrigating canals and nearly if not quite double that length of laterals and distributors have been built.

A Promising Field.

The public importance of irrigation will be appreciated when it is understood that the population of the United States doubles every thirty years, and that 33,000,000 acres, now arid, are so located as to be irrigable and will, when irrigated, comfortably support two hundred million people. Altogether there is scarcely a more promising field in the whole range of Hydraulic Engineering.

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- Hydro-mechanics.** Our Course in Hydraulic Engineering embraces a detailed study of the principles of hydromechanics, including the laws of hydrostatics and the flow of water through pipes and orifices. It involves the calculation of sizes of pipes and conduits to convey given discharges; the study of head and velocity; the efficiency of motors; construction of overshot, breast, undershot, Poncelet, Impulse, or Pelton, and all the various classes of impulse and reaction turbines, together with the sluices, gates, penstocks, governors, and wheel connections, etc.
- Water Motors.**
- Hydraulic Machinery.** Under the head of hydraulic machinery it treats of pumps of all kinds and classes; electric, water-power, single direct and duplex direct-acting steam, fly-wheel steam, high duty, rotary, centrifugal, pulsometer, etc. It covers thoroughly the details of hydraulic cranes, elevators, presses, jacks, accumulators, intensifiers, valves, pipes, fittings, and in fact the whole subject of hydraulic machinery, as far as it is possible to do in a course of this kind.
- Water Works.** The instruction on water-works takes up the subject of water supply in all its various phases: reservoirs, masonry and earth-work dams, etc. It will qualify the hydraulic engineer to make accurate surveys; to calculate the prism of the principal section of his canal at the headworks; to estimate the cost of siphons and aqueducts; to construct reservoir walls; determine the profile and location of minor channels for the distribution system and to test pipes, hydrants, gates, etc.
- Municipal Water Supply.** The proper location of street mains with reference to the buildings to be supplied; the proper way of setting hydrants; the inspection of pipes to determine existing imperfections; the depth to which trenches for pipes should be excavated; the proper method of laying pipes; pipe joints, fittings, standpipes; excavations for the setting of hydrants; sizes of connecting pipes for fire hydrants, etc., etc., receive throughout full and careful attention.
- Opportunities for the Ambitious.** The young man in search of a profession; the draftsman, surveyor, or mechanic in search of promotion, and the practicing engineer in search of a paying speciality will do well to consider the advantages of hydraulic engineering and the merit of our course and method of teaching, by which a first-class technical education can be acquired with a minimum expenditure of time, money, and inconvenience.

CONDITIONS UNDER WHICH CERTAIN PRELIMINARY SUBJECTS MAY BE OMITTED.

Persons desiring to enroll in any of the courses of The Correspondence School of Civil Engineering who satisfy us that they are already proficient in the mathematical and physical subjects of the course for which they enroll will be permitted to omit such studies. There will be no reduction made in the price of the Scholarship, however, because of such omission.

PRICES OF SCHOLARSHIPS.

It is understood that these prices include a set of Bound Volumes of the Instruction and Question Papers, Drawing Plates, Keys, etc., and a separate volume of the Tables and Formulas of the student's course of study, fully indexed and conveniently arranged for reference, printed on fine paper, pages 6 by 9 inches, and bound in half leather. These are given to the student in addition to, and independent of, the Instruction and Question Papers, in pamphlet form, and the Drawing Plates, supplied to study from. These Bound Volumes are furnished to the student when he enrolls, the title remaining with us, however, until the Scholarship is paid in full.

I.—THE COMPLETE CIVIL ENGINEERING SCHOLARSHIP.

Price \$165.00 in Advance, or \$175.00 on the \$5.00 Installment Plan. Not sold on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Course for	Arithmetic,	Land Surveying,
Chief and	Algebra,	Mapping,
Division En-	Logarithms,	Railroad Location,
gineers,	Geometry and Trigonometry,	Railroad Construction,
Maintenance	Elementary Mechanics,	Track Work,
of Way of	Hydromechanics,	Railroad Structures,
Railroads;	Pneumatics,	Elementary Chemistry,
Track Su-	Heat,	Economic Geology of Coal,
pervisors;	Geometrical Drawing,	Economic Geology of Metals,
Civil, Min-	Mechanical Drawing,	Blowpiping,
ing, Mechan-	Elementary Graphical Statics,	Mineralogy,
ical, Electric	Strength of Materials,	Drainage,
cal, and	Analysis of Stresses,	Sewerage,
Other Engi-	Proportioning the Material,	Streets and Highways,
neers; Sur-	Details of Construction,	Paving,
vectors;	Details, Bills and Estimates,	Water Wheels,
Draftsmen,	Steam and Steam Engines,	Hydraulic Machinery,
and All Who	Steam Boilers,	Water Supply and Distribution,
Wish a Civil	Locomotives,	Dynamos and Motors,
Engineering	Descriptive Astronomy,	Electric Lighting,
Education.	Surveying,	Electric Railways.

When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada and Mexico, \$15.00, payable in advance.

Civil Engineering Diploma.

Students who complete all the subjects of this Course (which includes all the subjects taught in The Correspondence School of Civil Engineering) and pass a final examination are awarded the Complete Civil Engineering Diploma.

II.—THE RAILROAD ENGINEERING SCHOLARSHIP.

Price \$45.00 in Advance, \$50.00 on the \$5.00 Installment Plan, or \$55.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Course for Civil Engi- neers, Sur- veyors and Assistants, Draftsmen, Roadmas- ters, Track Foremen, Etc.	Arithmetic, Algebra, Logarithms, Geometry and Trigonometry, Elementary Mechanics, Hydromechanics, Pneumatics, Geometrical Drawing, Mechanical Drawing,	Strength of Materials, Surveying, Land Surveying, Mapping, Railroad Location, Railroad Construction, Track Work, Railroad Structures.
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When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada and Mexico, \$3.50, payable in advance.

Railroad En- Students who complete all the subjects of this Course and
gineering pass a final examination are awarded the Railroad Engineer-
Diploma. ing Diploma.

III.—THE SURVEYING AND MAPPING SCHOLARSHIP.

Price \$28.00 in Advance, \$33.00 on the \$5.00 Installment Plan, or \$37.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Course for Draftsmen, Chainmen, Rod men, Transitmen, and Other Surveyors' Assistants, Etc.	Arithmetic, Use of Letters in Algebraic Formulas, Geometry and Trigonometry,	Geometrical Drawing, Surveying, Land Surveying, Mapping.
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When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada and Mexico, \$1.25, payable in advance.

Surveying and Mapping Students who complete all the subjects of this Course and
Diploma. pass a final examination are awarded the Surveying and
Mapping Diploma.

IV.—THE BRIDGE ENGINEERING SCHOLARSHIP.

Price \$45.00 in Advance, \$50.00 on the \$5.00 Installment Plan, or \$55.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Course for Arithmetic, Civil Engi- Algebra, neers, Su- Logarithms, pervisors of Geometry and Trigonometry, Bridges and Elementary Mechanics, Water Sta- Hydromechanics, tions, Bridge Pneumatics, Builders, Geometrical Drawing, Bridge Office Employees, Draftsmen, Template Makers, In- spectors, Structural Iron Work- ers, Etc.	Mechanical Drawing, Elementary Graphical Statics, Strength of Materials, Analysis of Stresses, Proportioning the Material, Details of Construction, Details, Bills and Estimates.
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When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada and Mexico, \$3.50, payable in advance.

Bridge Engi- Students who complete all the subjects of this Course and
neering Di- pass a final examination are awarded the Bridge Engineering
ploma. Diploma.

V.—THE MUNICIPAL ENGINEERING SCHOLARSHIP.

Price \$55.00 in Advance, \$60.00 on the \$5.00 Installment Plan, or \$65.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Course for Arithmetic, City Engi- Algebra, neers, Con- Logarithms, tractors, Geometry and Trigonometry, Surveyors Elementary Mechanics, and Assist- Hydromechanics, ants, Drafts- Pneumatics, men, Etc. Mechanical Drawing,	Strength of Materials, Surveying, Land Surveying, Mapping, Drainage, Sewerage, Streets and Highways, Paving.
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When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada, and Mexico, \$4.50, payable in advance.

Municipal Engineering Diploma.

Students who complete all the subjects of this Course and pass a final examination are awarded the Municipal Engineering Diploma.

Course for Civil, Mining, Mechanical, and Other Engineers, Surveyors, and Their Assistants, Draftsmen, Etc.

VI.—THE HYDRAULIC ENGINEERING SCHOLARSHIP.

Price \$55.00 in Advance, \$60.00 on the \$5.00 Installment Plan, or \$65.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Arithmetic,	Strength of Materials,
Algebra,	Surveying,
Logarithms,	Surveying and Mapping,
Geometry and Trigonometry,	Steam and Steam Engines,
Elementary Mechanics,	Steam Boilers,
Hydraulics,	Water Wheels,
Pneumatics,	Hydraulic Machinery,
Geometrical Drawing,	Water Supply and Distribution.
Mechanical Drawing,	

When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada, and Mexico, \$4.00, payable in advance.

Hydraulic Engineering Diploma.

Students who complete all the subjects of this Course and pass a final examination are awarded the Hydraulic Engineering Diploma.

Course for Those Who Wish Instruction in Mathematics and Physics Only.

VII.—THE MATHEMATICS AND PHYSICS SCHOLARSHIP.

Price \$20.00 in Advance, \$24.00 on the \$5.00 Installment Plan, or \$26.00 on the \$2.00 Installment Plan.

SUBJECTS TAUGHT:

Arithmetic,	Elementary Mechanics,
Algebra,	Hydromechanics,
Logarithms,	Pneumatics,
Geometry and Trigonometry,	Heat.

When sold on the \$5.00 installment plan the first payment is \$5.00 and the balance is payable at the rate of \$5.00 per month.

When sold on the \$2.00 installment plan the first payment is \$2.00 and the balance is payable at the rate of \$2.00 per month.

Additional charge for postage to students residing in countries of the Universal Postal Union, outside of the United States, Canada, and Mexico, \$2.25, payable in advance.

Certificate of Proficiency. Students who complete all the subjects of this Scholarship and pass a final examination are awarded the Mathematics and Physics Certificate of Proficiency.

SEPARATE STUDIES OF THE MATHEMATICS AND PHYSICS SCHOLARSHIP.

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Mechanical Drawing.

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AND
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COURSES.)

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Steam and Steam Engines.

(Hydraulic Engineering Course.)

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Steam Boilers.

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PART TWO, 92 PAGES.—Boiler Fittings: Safety Valve; Dead-Weight Safety Valve; Lever Safety Valve; Spring Safety Valve: Area of Safety Valve: Directions for Use and Care of Safety Valve: Feed Apparatus; Feed Water Heaters; Economizers: Steam Gauge; Gauge Cocks and Water Gauges: Fusible Plugs: Blow-Out Apparatus: Dome and Dry Pipe: Manhole: Mud-Holes and Handholes—Furnace Fittings: Grates: Dead Plate: Argand Steam Blower: Bridge—Chimneys: Natural Draft: Forced Draft—Management, Setting and Care of Boilers—Fuels: Firing; Spreading, Alternate, Coking Firing; Mechanical Stokers—Boiler Setting: Boiler and Pipe Covering; Installation of Complete Steam Plant; Steam Pipes—Incrustation; Remedies for Incrustation: Wear and Tear; Corrosion; Leakage; Overheating: Inspection and Testing: Boiler Explosions; Prevention: Management and Care of Boilers; Rules and Directions; Boiler Trials; Code of Rules for Boiler Trials—Steam Appliances: Separator: Steam Loop: Injector; Pumps.

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Dynamos and Motors.

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SAMPLE PAGES OF INSTRUCTION PAPERS.

We do not send out Instruction Papers for examination. Intending students can learn how they are written and illustrated and the subjects treated in them, from the following sample pages.

Sample Page of Instruction Paper. Subject—Analysis of Stresses.

The length of span, number of panels, and the amount of both live and dead loads, will be assumed to be the same as in the example for curved chords, explained in Art. 1.

The general form of the truss will also be the same, except that while the heights of the truss at the hips and at the center

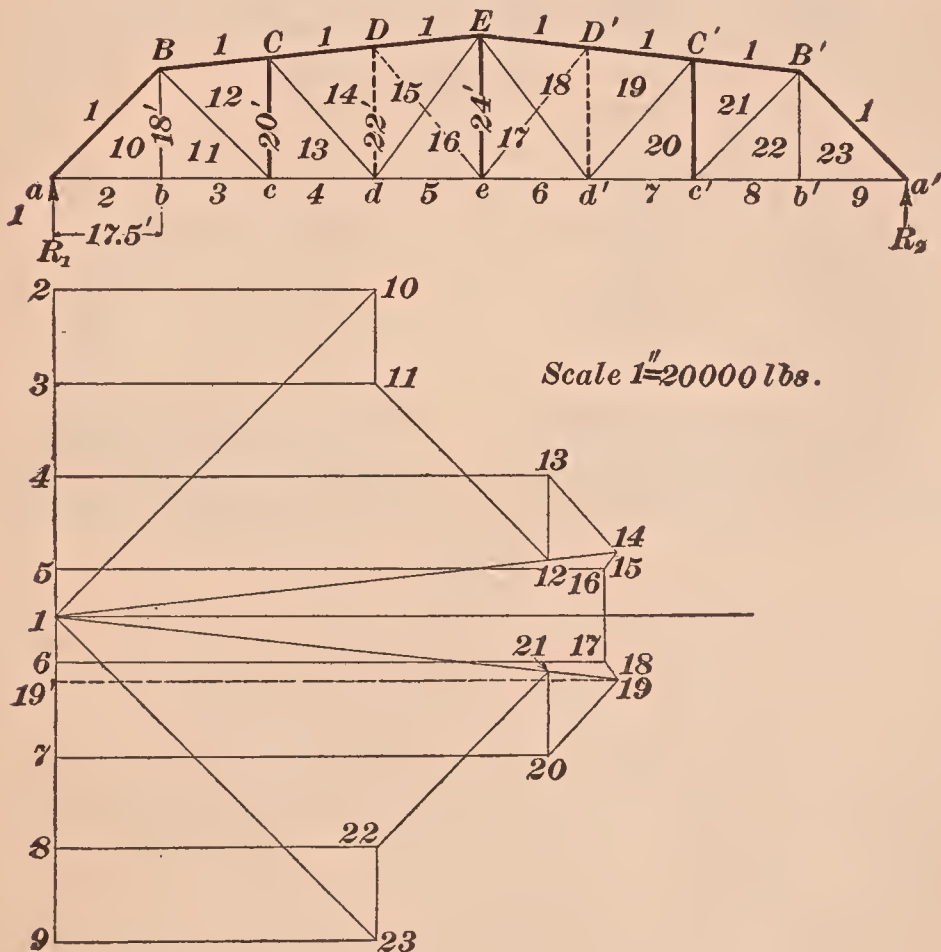


FIG. 3.

will be, respectively, 18 and 24 feet, as in the former example, the upper chord will be straight between those points, as represented in Fig. 3.

Sample Page of Instruction Paper. Subject—Proportioning the Material.

PROPORTIONING THE MATERIAL FOR TENSION MEMBERS.

6. According to item (i) of the Specifications, the sectional area for the main tie, required by item (g) (see stress sheet) is $\frac{27,500}{10,000} + \frac{9,800}{20,000} = 3.24$ sq. in. The section is made up of two bars $2'' \times \frac{1}{16}'' = 3.25$ sq. in. As the material composing the required section is determined for each member, the student should note it upon his copy of the stress sheet; it should be marked along the member in the *right* half of the diagram of the truss. According to the same items of the Specifications, the sectional area required for the hip vertical Bb is $\frac{16,200}{10,000} + \frac{4,600}{20,000} = 1.85$ sq. in. It is made up of two bars each 1 inch square = 2.00 sq. in.

The sectional area required for the counter Cc' is $\frac{13,750}{10,000} = 1.38$ sq. in. It is desirable that the diagonal members in the center panel should each be made up of two bars, rather than one bar. As item (m) specifies that no diagonal rod shall have a less area than $\frac{3}{4}$ of a square inch, which is practically to the effect that no diagonal rod shall be less than $\frac{7}{8}$ of an inch square (= 0.766 sq. in.) or 1 inch round (0.785 sq. in.), the section of the counter Cc' is made up of two bars $\frac{7}{8}$ of an inch square = 1.53 sq. in. The sectional area required by the live and dead load stresses in the panel ab or bc of the lower chord is $\frac{32,400}{10,000} + \frac{13,900}{20,000} = 3.94$ sq. in.

In highway bridges the lower chords are often proportioned with reference to the live and dead load stresses only; if this were done in the present case the section could be made up of two bars $2\frac{1}{2}'' \times \frac{1}{16}'' = 4.06$ sq. in. Likewise, for the center panel cc' of the lower chord, the sectional area required by the

Sample Page of Instruction Paper. Subject—Details, Bills, and Estimates.

(f) **Another Form of Shoe.**—Although the form of shoe shown on Plate XVI is commonly used for bridges of moderate span, other forms are often used. A form of shoe similar to that shown in Fig. 3 is used for long and heavy spans.

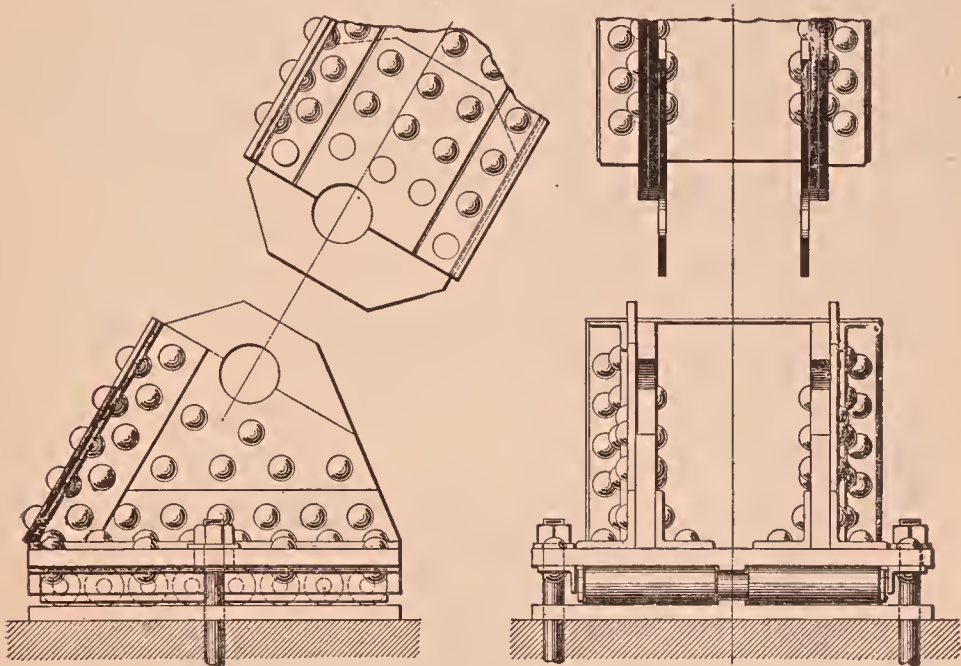


FIG. 3.

A side elevation and rear elevation of the shoe are shown, and also a side elevation of the lower end of the end post, with a section on the center line of the same.

In this shoe the bearings of the end post upon the pin are so nearly opposite those of the shoe-standards as to produce but a comparatively small amount of bending moment in the pin. The standards of the shoe are supported laterally by a plate corresponding to the cover-plate of the end post. The rollers are held in position by angles attached to the shoe-plate, thus allowing the accumulations of dirt on the bed-plate to be cleaned out between the rollers. The anchorage is given by anchor-bolts passing through slotted holes in the shoe-plate.

**Sample Page of Instruction Paper. Subject—Steam and
Steam Engines.**

STEAM CONSUMPTION.

The indicator card also enables us to find approximately the amount of steam consumed by the engine. In referring to the steam consumption, it is customary to take as a unit the *steam consumed per horsepower per hour*.

Take a point *a* on the expansion line before the release (see Fig. 43); measure the pressure from the vacuum line, and from

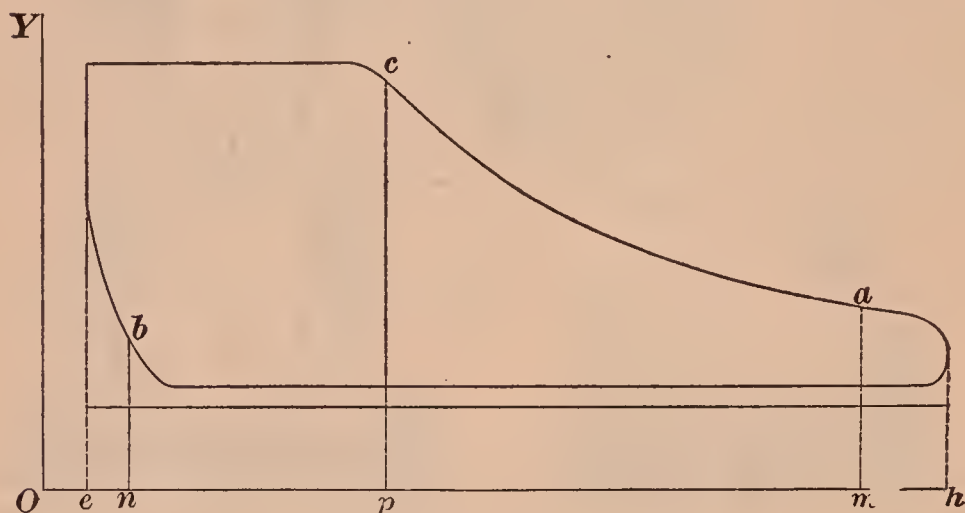


FIG. 43.

column 8 of the steam table, find the weight of a cubic foot at that pressure. The cubic contents of the cylinder (including the clearance) up to the point *a*, multiplied by the weight per cubic foot, must give the weight of steam in the cylinder at this instant. Were it not for compression and cylinder condensation, the above weight would represent the steam consumed per stroke. On account of compression, some steam is saved by the early closure of the exhaust port. To find its weight, take a point *b* on the compression curve, measure its pressure from vacuum as before, and compute the weight of the steam in the cylinder up to *b*. Subtract this from the weight first obtained and the difference will be the weight of steam per stroke, accounted for by the indicator. Multiply this weight per stroke

Sample Page of Instruction Paper. Subject—Surveying.

76. Practical Method of Determining Tangent and Chord Deflections.—Let it be remembered for a basis of calculation that the chord deflection for a 1° curve, the chord being 100 feet in length, is 1.745 feet; for a 2° curve, double the deflection for a 1° curve, or 3.49 feet, and so on. The tangent deflection being one-half the chord deflection, for a 1° curve it will be .873 foot, for a 2° curve it will be 1.745 feet, etc.

Distances measured either on chords or tangents are expressed in decimal parts of a station, which is 100 feet, and is assumed as 1. Thus, the tangent deflection for 75 feet will be expressed as the tangent deflection for .75 of a station. This expression is, however, confined entirely to the calculation, and is *spoken of* as the tangent deflection for 75 feet. Fig. 47 will be used to demonstrate the principle upon which tangent deflections are based.

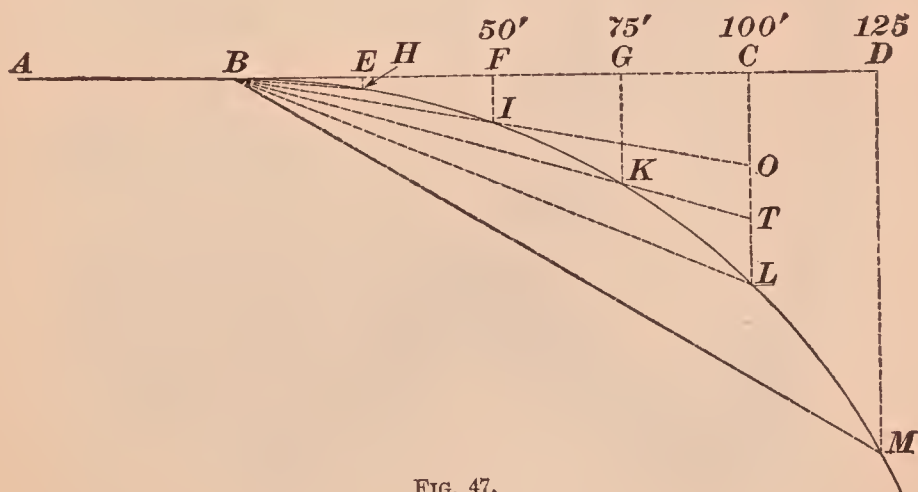


FIG. 47.

Let AB be a tangent, and B the P. C. of a 2° curve to the right. From Art. 76, we determine the chord deflection for 100 feet chord of a 2° curve to be 3.49 feet. The tangent deflection is one-half the chord deflection, or 1.745 feet.

Let $BC = 100$ feet, a full station (which express as 1), then CL , the tangent deflection at C , will = 1.745 feet, for, since this

Sample Page of Instruction Paper. Subject—Mapping.

24. Shore Lines.—The sea-shore is represented by a line following all its windings and indentations. A short distance

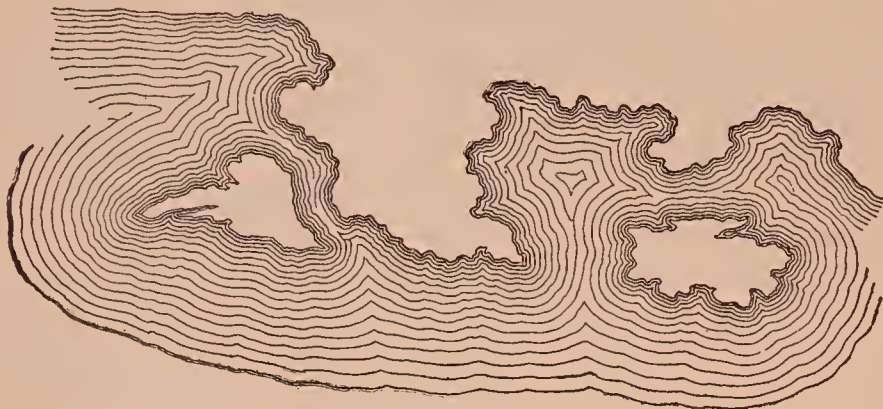


FIG. 24.

from the shore line, a parallel line is drawn, and a little farther removed a second parallel, and so on, as in Fig. 24.

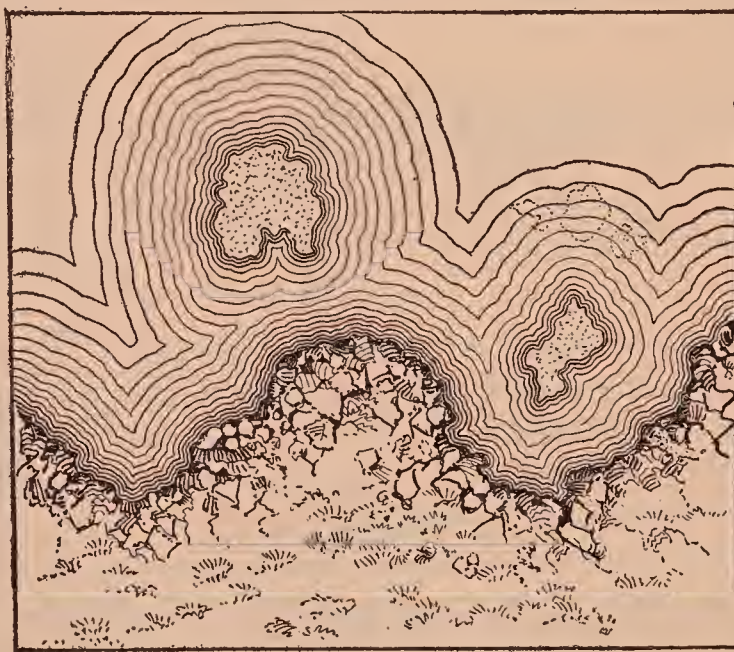


FIG. 25.

An abrupt and rocky shore is shown in Fig. 25. The irregular dotted surfaces surrounded by shore lines represent sand bars. The dotted outlines beyond the shore lines represent

Sample Page of Instruction Paper. Subject—Railroad Location.

24. Spur Lines.—At certain points of the main line, two and sometimes three different routes will present themselves for reaching another point of that line, and require the running of *spur lines* to determine the most advantageous route. The

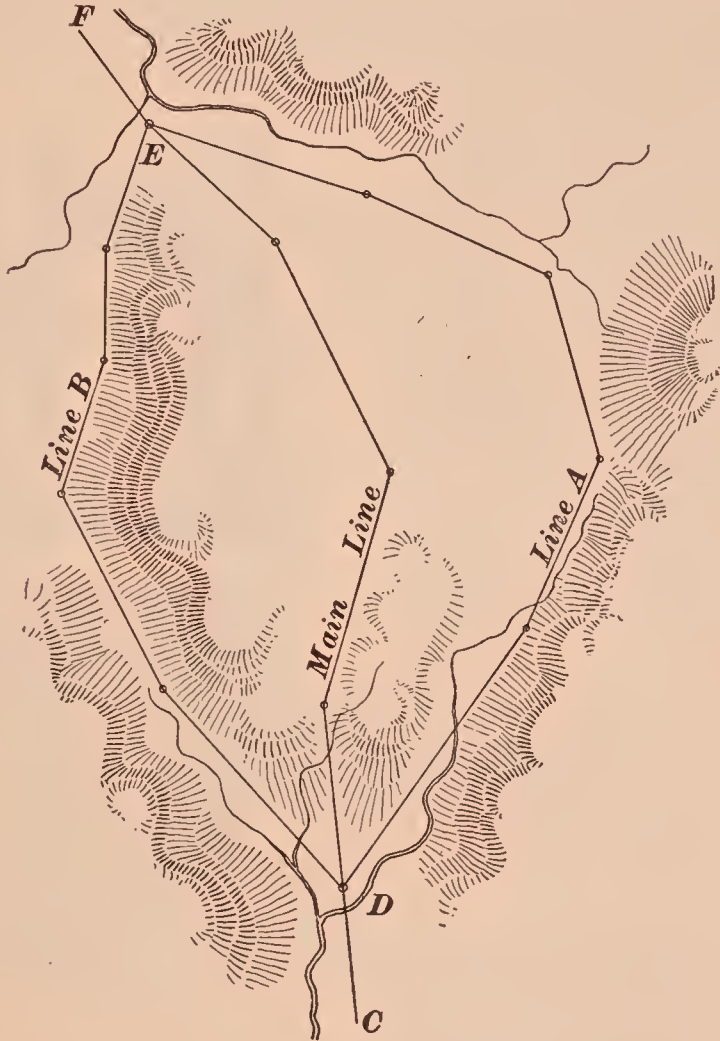


FIG. 4.

main line being run, the spur lines are *tied into* it, designating them by different letters, as *Line A*, *Line B*, etc. The comparative advantage of the different alignments will show themselves in the *plat*. Their comparative profiles are commonly shown by platting them in different colors. A case requiring

Sample Page of Instruction Paper. Subject—Railroad Construction.

52. Coffor Dams.—For depths of stagnant water greater than four feet and for less depths having a current, the clay dam is replaced by a coffer dam. This construction consists of two rows of piles which are driven enclosing the foundation site. The distance apart of these rows of piles, as well as the spacing of the piles in the rows, will depend upon the depth of the water surrounding the foundation site, and the nature of the material into which the piles are to be driven. The piles will also be required to support a platform, upon which are placed the derricks, hoisting machinery, and building material used during construction.

The usual form of construction of a coffer dam is shown in Fig. 43. Two rows of piles *P, P* are firmly driven, enclosing the foundation area. Longitudinal pieces of squared timber *W, W* called **string pieces** or **wales** are bolted to the piles a little above the water level. Directly opposite the string pieces on the inside of the piles, **guide pieces**

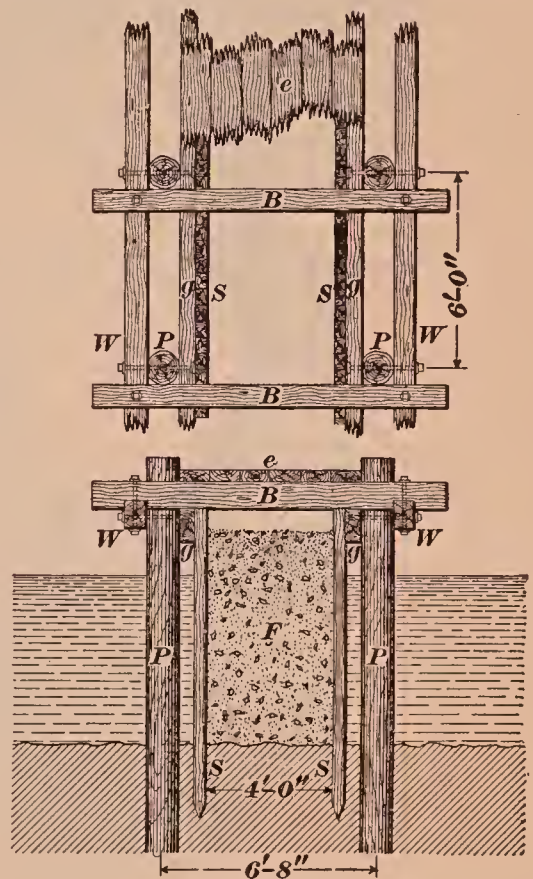


FIG. 43.

g, g are bolted, the same bolt passing through both string piece and guide. The guide pieces serve to keep the sheet piles *S, S* in line while being driven. Cross-timbers *B, B*, called **binders**, are notched down on the string pieces to which they are bolted. The depositing and ramming of the puddle tend to cause the rows of piles to spread. The binders prevent this and

Sample Page of Instruction Paper. Subject—Track Work.

A section of track ballasted with broken stone is shown in Fig. 23. The ballast extends from 10 inches below the bottom of the ties to the level of their tops, and is shouldered outward from the ends of the ties, as shown in the figure. The side ditches are 12 inches in depth, the slope of the ballast and that of the ditch forming a practically straight line. The slopes of the cuts given in Fig. 23, as well as those given in Figs. 21 and 22, are 1 horizontal to 1 vertical. This is the steepest slope at which earth will stand. The certain effect of weather is to cause the slope to cave, flattening it and at the same time filling up the ditches. In all recent railroad construction, where the finances of the company will permit, the slopes of both cuts and embankments are made the same, viz., $1\frac{1}{2}$ horizontal to 1 vertical. Cuts can be widened much more cheaply before than after track-laying, but it is often a difficult question to decide *where it is safest to economize*.

The proper time to clean ditches is in the fall, commencing about October 1 and finishing by or before November 1. Occasionally the slopes of a cut cave in so badly that ditches require

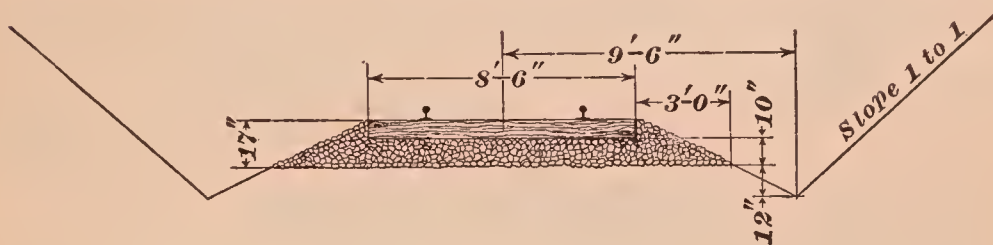


FIG. 23.

frequent clearing. The only permanent cure is to widen the cut to such an extent that caving material cannot encroach upon the ditches and track. Some writers on track insist that there should be no side ditch nearer than 10 feet from the rails, nor slopes less than $1\frac{1}{2}$ horizontal to 1 vertical. This would require a roadway at least twenty-four feet in width for a single track and involve an outlay which would prohibit the building of nearly all new lines.

The roadway and track sections given in the preceding pages

Sample Page of Instruction Paper. Subject—Sewerage.

80. Reference Points.—The position of the sewer line, as located, should be so fixed by measurements to permanent objects that its exact position may, at any subsequent time, be readily determined. This is generally best accomplished by observing the points where the line of the sewer is intersected by the prolonged lines of the sides of buildings and other well-defined lines of permanent objects, and also measuring along the prolonged line the distance from the nearest corner of each object to the center line of the sewer.

The buildings selected should be of a permanent character, such as brick buildings, and the measurement of both the offset

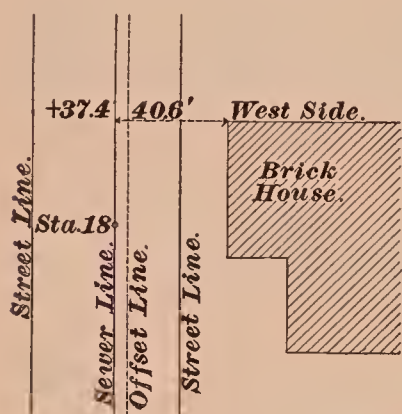


FIG. 10.

and the plus should be taken to the nearest tenth of a foot. This method of reference is clearly shown in Fig. 10. As there shown, the line of the west side of the brick house, prolonged to the sewer line, intersects the latter line at Station $18 + 37.4$ and the center line of the sewer is 40.6 feet from the southwest corner of the house.

The same method can be easily employed to locate the points where the sewer line is intersected by street lines, the prolongation of the street line being made by simply placing the eye in range with the fence. Each point where an angle occurs in the line of the sewer should also be located by reference points. As the angle will often occur at a point where there is no line of a permanent object in range, the location of the point will generally be best fixed by measurement to two or more permanent objects, as shown in Fig. 11. This method of reference, however, is not as satisfactory as that shown in Fig. 10.

81. Leveling and Level Notes.—When the sewer lines have been finally located, the levels should be taken over the lines of all the sewers. This can generally be most expeditiously

SPECIAL PRICES FOR TWO OR MORE SCHOLARSHIPS TO THE SAME PERSON.

A considerable reduction in the prices of Scholarships will be made to persons who wish to purchase more than one Scholarship at the time of enrolling. Thus, for instance, a special rate will be made on the Full Scholarship in The Correspondence School of Mines and the Complete Mechanical Scholarship of The Correspondence School of Mechanics, or on two or more of any of the Scholarships. Intending students wishing to enroll for more than one Scholarship at the same time should write, asking for prices.

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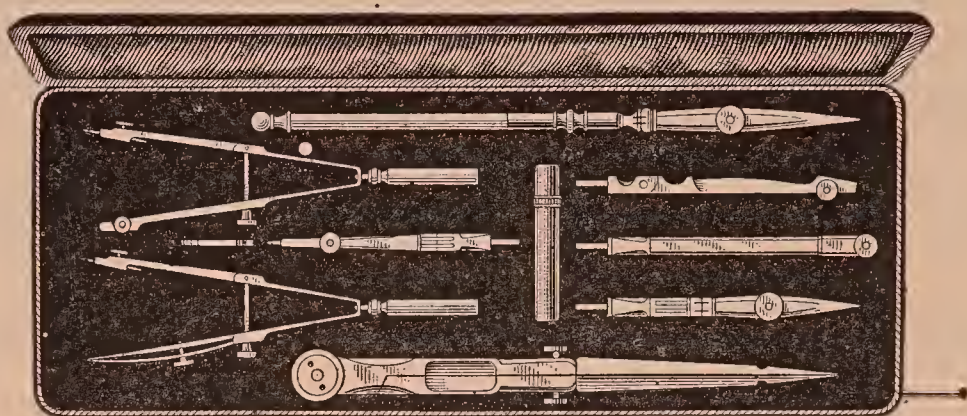
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One Dixon Drawing Pencil	0.10	0.02
One ¾-oz. bottle Higgins' Drawing Ink	0.25	0.10
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\$10.90

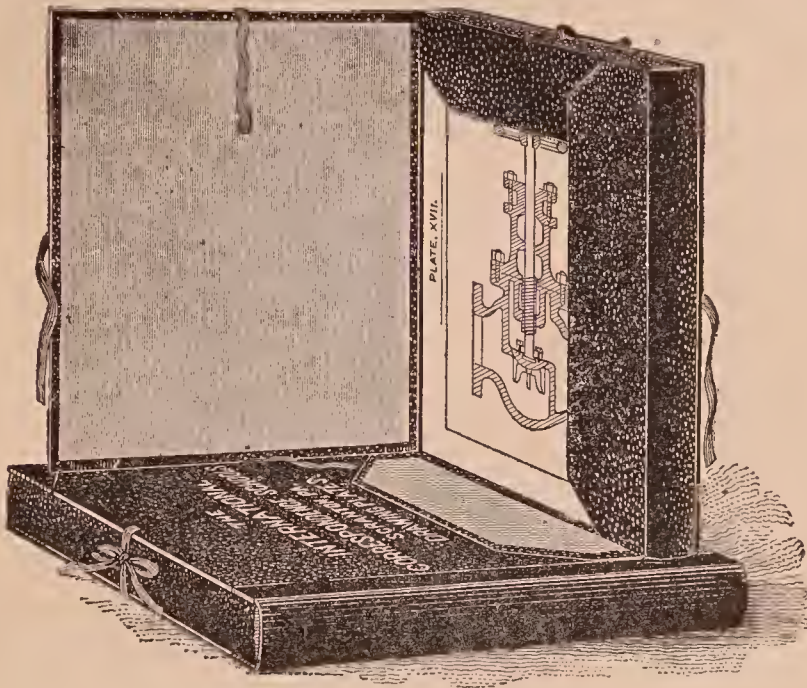
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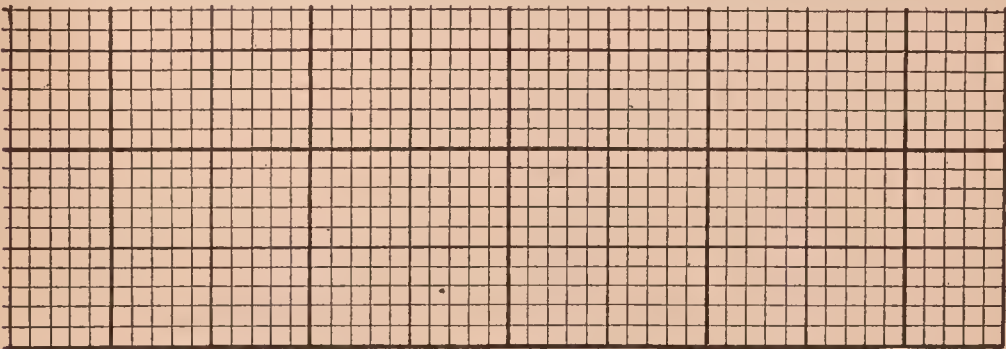
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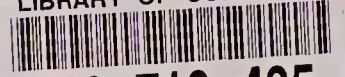
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